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Lifestyle Factors and Social Determinants as Predictors of Weight/Body Mass Index

Uthman Alhaji Baba
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College of Health Sciences

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Uthman Alhaji Baba

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Walden University
2020

Abstract

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by

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MPA, University of Abuja, 2010

MTropMed, University of Liverpool, 2004

MBBS, University of Ilorin, 1991

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

Public Health Epidemiology

Walden University

May 2020

Abstract

Obesity is a major public health concern that includes the risk of developing cardiovascular disease and premature death in adults. Previous studies have established the relationship between gender, educational level, household income and respondents' weight but additional research is needed to factor the nature of education in relation to gender differences, diet, and other important behavioral mediators such as social determinants. The purpose of this quantitative cross-sectional study is to determine the extent to which frequency of physical activity, household income, social determinants of health (money for balanced meals, finances at the end of month, and poor mental health), respondent sex, and diet (fruit, fruit juice, potato, and dark green vegetable consumption) predict respondent weight/Body Mass Index (BMI) among household adults in the United States. Social cognitive theory provided the theoretical framework for this research. Data from the NCCOR 2017 Behavioral Risk Factor Surveillance System was used for this study. The target population was adults living in households in the United States. Binary logistic regression was used to analyze data. Results revealed statistically significant associations between household income (>$75,000), race/ethnicity (African American), and weight/BMI (p = 0.025, Odds = 3.50, 95%CI = 1.17, 10.26), and (p = 0.05, Odds = 3.00, & 95% CI = 0.90, 9.08), respectively, indicating that household income and race ethnicity are predictors of weight/BMI. The results of this study could be used to promote positive social change through obesity intervention programs, thereby improving population health, increasing life expectancy, and improving human productivity.

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Dedication

I dedicated this Dissertation to my parents, Alhaji Muhammad Baba and Hajiya Hajara Umar for their continuous prayers and words of wisdom that carried me to this level.

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Glory is to Almighty God that gave me strength, stamina, and live to have reached this capstone stage of my dissertation. My sincere appreciation goes to my wife, parents and children who have played great role in one way or the other morally and financially to support and encourage me in this studying process. I also want to thank my friends who are still with me and those who have decided to quit from me because I did not have enough time for them. Most importantly word cannot express itself. I am grateful to Dr. Diana Naser, my committed chair and mother, I will never forget her in my life as she is a true God gift to help me channel this journey and for her wonderful guidance throughout all days and nights, I sincerely appreciate her. I also want to thank my committee member who is also methodology expert, Dr. Brunet for his immense contribution in this journey. Sir, you are awesome. I also want to thank my URR member, Dr. Ahmet Sapci for his eminent support and contributions to my progress in this journey.

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Chapter 1: Introduction to the Study

Introduction

Overweight and obesity can be defined as possessing abnormal excessive body fat accumulation that can cause harm to one's health (Lavie et al., 2017). Body mass index (BMI) is a measure which is commonly used in the estimation and monitoring of overweight and obesity in the population and it is expressed mathematically as (BMI = Kg/m^2). Obesity is associated with some chronic diseases and these include hypertension, Type 2 diabetes mellitus (T2DM), cardiovascular diseases (CVDs), arterial stiffening dyslipidemia, chronic liver disease, bronchial asthma, musculoskeletal disorders, sub-fertility, renal failure, psychosocial disorders, and some types of oncological diseases (Djalalinia, Qorbani, Peykari, &Kelishadi, 2015). Obesity has been declared a global epidemic that affected 500 million people globally and it is expected to affect one billion people by the year 2030 (Otang-Mbeng, Otonola, &Afolayan, 2017). This is because the prevalence of obesity is on the rise in both industrialized advanced economies and middle to low income countries (Djalalinia et al., 2015). This declaration has made overweight and obesity a clinical and public health concern worldwide (Health and Social Care Information Center, 2015). The prevalence of overweight and obesity among older adults has been considered high in the systematic analysis for global burden of obesity disease (Ng et al., 2014).

Researchers have established the relationship between gender, educational level, household income and overweight/obesity (Hassan-Zadeh, 2017; Arruda et al., 2015).Lee (2017) in his study conducted in Korea found that highly educated women were more likely to control their body weight which was not mediated by economic resources, and this was not found in men in Korea. In addition, Hassan-Zadeh et al. (2014) identified that gender affects most of the known factors related to health such as education, income, occupation, social networks, physical and social environments, and employment status. These factors were used by Hassan-Zadeh et al. (2014) to control for the relationship between diet, social determinants, and lifestyle behavior with weight/BMI and couldprovide a better result that could help in the intervention of adulthood obesity.

This study, on the predictors of adults' obesity in the United States, could be relevant to examining the impact of these predictors on weight/obesity status of the adults in the 50 states. In addition, I used control factors such as geographic location, race, age, marital status, education, and employment to reduce their effects on weight/obesity and provided a precise result to plan for an obesity intervention program for the adults in the 50 states of the United States.The potential positive social change that could result from this study is the ability to identify weight/BMI predictorsthat could help in reducing/eliminating obesity among the United Statespopulation,which could lead to prevention of some chronic diseases. This chapter includes the background of the study, problem statement, purpose, research questions, theoretical framework, nature of the study,definitions, assumptions, scope and delimitations, and limitations.

Background

The prevalence of obesity is increasing, especially in countries where it was not a problem in the past (Lee, 2017). Many factors are responsiblefor this increase, such as lifestyle factors, diets, social determinants, education, and household income (Lee, 2017).

In a study to investigate differences in gender and the impact of pension income, sociodemographic variables, and health status on probability to become obese at postretirement age (≥ 67 years), Arbel,Fialkoff, and Kerner(2019) reported an inverse relationship between high income pension and body mass index (BMI). In another study conducted to understand the social determinants of inequities in under-nutrition among under 5 years of age, Chatterjee et al. (2016) showed that the most important predictor of undernutrition and underweight was low income in India and in other middle- to low-income countries unlike in advanced economic countries. Puciato et al. (2019) assessed the association between physical activity and the income status among working age groups and demonstrated that irrespective of gender, low-income status was characterized by physical inactivity, while women with medium income and men with high income were most physically active. In another study that explored the relationship of household income at different stages of childhood with early childhood weight status in a nutrition transition setting, i.e. a developing nation that has both an underweight and overweight population, Schmeer (2010) suggested that abnormal BMI may have very high consequences for person's health.

Elinder, Heinemana, Zeeban, and Patterson (2014) analyzed how health related behaviors and weight status differed by age group, gender, and family socioeconomic status and suggested an inverse relationship between parental educational level and BMI. Lee (2017) in his study conducted in Korea examined how the relationship between education and weight status operates in relation to gender, he suggested that highly educated women were more likely to control their body weight which was not mediated by economic resources, and this was not found in Korean men. In addition, Hassan-Zadeh et al. (2014) identified that gender affects most of the known factors related to health such as education, income, occupation, social networks, physical and social environments, and employment status. I used some of these factors in this studyto control for the relationship between diet, social determinants, and lifestyle behavior with weight/BMI in order to address an existing gap in literature.

Problem Statement

Obesity is a major public health concern that includes the risk of developing CVDand preventable premature death in adults (Umer et al., 2017).Arbel et al. (2019) advocated that previous studies identified obesity and overweight as the fourth leading risk factor of mortality worldwide and attributed approximately 3.2-5.0 million deaths every year to obesity and overweight.Yoon et al. (2006) identified thatcountries experiencing remarkable economic growth and emergence of obesogenic environment havean increase in prevalence of overweight and obesity. Power and Schulkin (2008) advocated that obesity is more prevalent among women and attributed this to the fact that women bodies store fats naturally than their men counterparts. In addition to this, Davis et al. (2009) attributed women's experience of childbirth at their active reproductive age to increase the probability of obesity in women significantly.

Previous studies have established the relationship between gender, educational level, household income and respondents' weight. Lee (2017) found that highly educated women were more likely to control their body weight which was not mediated by economic resources, and this was contrary to what was found in men who had positive relationship between education and overweight/obesity in Korea. The study by Lee (2017) however, merits future studies that factor nature of education in relation to gender differences in other important behavioral mediators such as social determinants (money for balanced meals and poor mental health) that help in checking unhealthy lifestyles, especially in rapidly developing nations.This study was conducted to determine the relationship between lifestyle factors, social determinants and weight/BMI to address this gap in the literature as previous studies have not addressed nature of education in relation to gender differences in the identified behavioral mediators such as social determinants (money for balanced meals and poor mental health) that could help in checking unhealthy life styles particularly in the rapidly developing nations.

Purpose

The purpose of this study wasto determine the extent to which frequency of physical activity, household income, social determinants of health money for balanced meals, finances at the end of month, and poor mental health), respondent sex, and diet (fruit, fruit juice, potato, and dark green vegetable consumption) predict respondent weight/BMI in the United States of America, after controlling for potential confounders (geographic location, race, age, marital status, education, and employment). The independent variables were frequency of physical activity, household income, social determinants of health, respondent sex, and diet while the dependent variable was respondent weight/BMI.

Research Questions

Research Question 1 (RQ1):To what extent do frequency of physical activity, household income, and respondent sex predict respondents' weight/BMI after controlling for geographic location, race, age, marital status, education, and employment?

Null Hypothesis ($H_0$1):Frequency of physical activity, household income, and respondent sex do not predict respondents' weight/BMI after controlling for geographic location, race, age, marital status, education, and employment.

Alternative Hypothesis$H_1$1:Frequency of physical activity, household income, and respondent sex do predict respondents' weight/BMI after controlling for geographic location, race, age, marital status, education, and employment.

Research Question 2 (RQ2):To what extent do social determinants of health (money for balanced meals, finances at the end of month, and poor mental health), household income, and respondent sex predict respondents' weight/BMI after controlling for geographic location, race, age, marital status, education, and employment?

Null Hypothesis ($H_0$2):Social determinants of health (money for balanced meals, finances at the end of month, and poor mental health), household income, and respondent sex do not predict respondents' weight/BMI after controlling for geographic location, race, age, marital status, education, and employment.

Alternative Hypothesis ($H_1$2):Social determinants of health (money for balanced meals, finances at the end of month, and poor mental health), household income, and respondent sex do predict respondents' weight/BMI after controlling for geographic location, race, age, marital status, education, and employment.

Research Question 3 (RQ3): To what extent do diet (fruit, fruit juice, potato, and dark green vegetable consumption), household income, and respondent sex predict respondents' weight/BMI after controlling for geographic location, race, age, marital status, education, and employment?

Null Hypothesis ($H_0$3) Diet (fruit, fruit juice, potato, and dark green vegetable consumption), household income, and respondent sex do not predict respondents' weight/BMI after controlling for geographic location, race, age, marital status, education, and employment.

> Alternative Hypothesis ($H_1$3) Diet (fruit, fruit juice, potato, and dark green vegetable consumption), household income, and respondent sex predict respondents' weight/BMI after controlling for geographic location, race, age, marital status, education, and employment.

Framework

I used social cognitive theory (SCT) as the theoretical framework for this study because it can be used to link peoples' confidence in adaptation to new behavior trends, especially if they perceive that they have relative advantage over the current behaviors. The success of this new behavior stands a better chance to succeed in addressing overweight/obesity especially in developing nations. McAlister et al. (2008) statedthat new behavior is compatible with one's daily routine and aligned with sociocultural values and priorities. Becauseobesity prevention is predominantly a family-based intervention, I used SCT to ground this study. Researchers have used SCT in their intervention process to reduceobesity/overweightwith good results(Nerud& Samra, 2017).Inthis study, I usedfrequency of physical activity, household income, social determinants of diseases, respondent sex, and diets topredict respondent weight/BMI that may lead to premature mortality, and I will the significance of the study to improve the life of the population and prevent overweight/obesity. I will discuss the theoretical framework further in Chapter 2.

Nature of the Study

I used a cross-sectional quantitative method for this study.The quantitative method was appropriate because I established the relationship between the dependent variable(overweight/obesity) and the independent variables(frequency of physical activity, household income, social determinants of health, respondent sex, and diet).The specific datasetthat I used for the secondary data analysis is NCCOR 2017 Behavioral Risk Factor Surveillance System (BRFSS), sponsored by the Center for Disease Control and Prevention, U.S. Department of Health and Human Services. The target population was adults living in households in all 50 states. I analyzed the data using binary logistic regression.

Definitions of Terms

Diet: Diet is the food and drink that is regularly consumed by people. It is however, clear that consumptions of diets that contains decreased saturated fat, decreased sugar contents, and high fruit and vegetable diet are inversely proportional to overweight and obesity and as such can be used in the prevention of obesity in adults' population (Makris & Foster, 2011).

Household Income: This is the measure of combined incomes of all people from 15 years and above living together in a particular household or place of residence irrespective of whether they are related or not and it includes every form of income, such as salaries/wages, and retirement income (Kagan, 2019).

Obesity:Obesity is defined as a measure of body mass index (BMI) and it is expressed mathematically as BMI $\geq$ 30 kg/m^2 and overweight as BMI $\geq$ 25kg/m^2 (Morgen & Sorensen, 2014). Social determinant of health is defined as conditions or circumstances, in which people are born, grow, live, work, and age (World Health Organization, n.d.) and its condition is shaped by political, social, and economic forces. However, a social determinant of obesity is defined as social and environmental factor that predict obesity mostly upstream that is based on intervention to address inequalities (Lakerveld&Mackenbach, 2017).

Assumptions

I assumed that the self-reported information for the BRFSS dataset such as height, weight, physical activity (at leisure time and occupational), and the frequency of physical activity is truthful. I also assumed the respondents correctly recalled their responses especially on the predicting variables such as household income, physical activity, diets, and social determinants.

Scope and Delimitations

This study is a cross-sectional and quantitative study and I used secondary data from the BRFSS administered by all 50 U. S. States, the District of Columbia, Puerto Rico, the U.S. Virgin Island, Guam, American Samoa, and Palau in 2016. The data collection was sponsored by Centers for Disease Control and Prevention (CDC), and U.S. Department of Health and Human Services and it is a representative of adults living in households. The BRFSS data were randomly collected annually with a large sample sizewhich may allow the study results to be generalizable to the larger population.

I believed that SCT was most suitable for this research study because it can be used to address the predicting and control variable that can affect the outcome variable (weight/BMI).I considered the use of the health belief model (HBM) and social ecological model (SEM) in addition to SCT for this research. However, since the HMB does not account for individual's attitudes, beliefs, or other individual determinants that dictate individual's acceptance of a health behavior, I did not use it. I also did not useSEM because it needs motivation for change in the environment.

Limitations

The most important limitation of this research was that variables such as calorie intake, social capital, and psychological state of the respondents were not directly available from the dataset. This was addressed by using similar variables provided in the dataset such as social determinants (money for balanced meal, and poor mental health), and diets (fruits, fruit juice, potato, and dark green vegetable consumption). Furthermore, lack of longitudinal data on individual body weight/BMI may lead to inability to derive further inference about the causal effect of some predictors such as educational attainment on changes in weight/BMI of the respondents. I addressed this byusinga cross-sectional design for this study.

Significance

The original contribution from this study is that this research could provide clarification in the prediction of weight/BMI from frequency of physical activity, household income, social determinants of diseases, respondent sex, and diet in the United States. These relationships are not well documented in literature (Lee, 2017). Furthermore, as obesity becomes more prevalent in countries where it was previously rare (Lee, 2017), and as overweight/obesity is identified as the fourth leading risk factor for global mortality (Arbel et al., 2019), the results of this study could be used to target an overweight/ obesity intervention and subsequently decrease premature mortality using community level intervention. This research could allow practical application as it is aligned with SCT that links peoples' confidence in adaptation to new behavior trends as they perceive that they have relative advantage over the unhealthy behavior. The results of this study could lead to identification of potential predictors of overweight/obesity and aid in the intervention of overweight/obesity in the society thereby reducing associated morbidity and mortality. The knowledge of the potential predictors and the outcome of intervention could bring about positive social change in the society through improvement in the health of the population, increase in life expectancy, and improvement in human productivity.

Summary

Obesity is a major public health concern that includes the risks of developing chronic diseases such as cardiovascular disease (CVD) and preventable premature death in adults (Umer et al., 2017).As fourth leading risk factor of mortality worldwide, obesity can be attributed to approximately 3.2–5.0 million deaths every year (Arbel et al., 2019).A main hypothesis of this study is that weight/BMI can be predicted by frequency of physical activity, household income, social determinants, diets, and gender, having controlled for geographical location, race, sex, marital status, education, and employment status because of their potential effects on weight/BMI. SCT will serve as the theoretical foundation of this study. Chapter 2 will include the findings of the literature search, a discussion of the literature review and theoretical framework.

Chapter 2: Literature Review

Introduction

Arbel et al. (2019) statedthat previous studies identified obesity and overweight as the fourth leading risk factor of mortality worldwide and attributed approximately 3.2─5.0 million deaths every year to obesity and overweight.Obesity is becoming more prevalent in countries where it was not a problem in the past (Lee, 2017). In the Western world, studies have linked higher level of education with lesser risk of obesity, but gender variation was inconclusive (McLaren, 2007). However,women were identified to have more prevalence of obesity because their bodies are adapted to store considerable quantity of fat because of the biological factors that are associated with reproduction (Power &Schulkin, 2008).Furthermore, studies have documented that differences seen in the prevalence of overweight and obesity according to gender vary with social and cultural factors identifying gender as an important social factor of obesity in addition to biological factors(Garawi, Devries, Thorogood, &Uauy, 2014; Wells, Marphatia, Cole, & McCoy, 2012).

In recent years, South Korean researchersfound that highly educated women are more likely to control their body weight with no mediation by economic resources; this finding is contrary to the positive relationship found in men between education and overweight/obesity, indicating that more educated Korean men are obese (Lee, 2017). However, this South Korean study conducted by Lee (2017)suggestedfuture studies that factor nature of education in relation to gender differences in other important behavioral mediators such as social determinants (money for balanced meals and poor mental health)that aidin checking unhealthy lifestyles especially in fast developing nations.

The purpose of this study wasto determine the extent to which frequency of physical activity, household income, social determinants of health, respondent sex, and diets predict respondent weight/BMI in the United States of America, after controlling for potential confounders (geographic location, race, age, marital status, education, and employment).This chapter contains the literature search strategy, literature review of recently published peer reviewed articles containing various predicting factors of weight/obesity(physical activity, household income, gender, social determinants, diet, geographic location, race, age, marital status, education status, employment status), and theoretical framework.

Literature Search Strategy

I implemented the search strategy for this literature review using accessible, available, and related databases in the Walden University Library and other related web sites. Some of the databases utilized to search for the relevant and related articles were National Collaborative on Childhood Obesity Research (NCCOR) Catalogue of Surveillance System, PubMed, Google Scholar, Science Direct, EBSCO Host, Science Direct, ProQuest Central, PsycInfo, Cumulative Index to Health and Allied Nursing Literature (CINAHL) Plus with Full Text, MEDLINE with Full Text, Web of Science, Walden University Dissertations and Theses, and Health Sciences. Most of the articles in this literature search were recently published between years 2014 to 2019. However, a few studies that includedvery specific and related variables to this studywere older than 5years.Articles used in this study were peer reviewed and written in English language.

The reviewed articles were based on related researches done on men and women irrespective of age.

In this literature search, the Boolean operator system of combining search terms with the connectors was used. The most used operator was “AND”;the least used were operators were ‘OR’ and “NOT”. The key words usedwere:*Lifestyle factors, physical activity, household income, gender, social determinants, diet, obesity, and weight/Body Mass Index.* These keywords produced about 2,000 related articles on obesity/overweight. Those selected were those that are related variables to this study and are mostly 1-5 years old (2014–2019). However, very few articles that are older than 5 years were also used.

Theoretical Framework

Social Cognitive Theory

This research is guided by theSCT which is a behavioral change model that places emphasis on social influence, especially on external and internal social reinforcement. According to Bandura (2004), SCT is an interpersonal theory that emphasizes mutual interactions of persons, behavior, and environment. I applied SCT to this research because it considers the unique way and social environment in which individuals acquire, maintain, and perform behavior that serves as the true goal in public health. This is supported by the views of Bandura (1986) that SCT is a framework that can be used to explainhumanbehavior as the product of the dynamic interplay of personal, environmental, and behavioral factors and referred to this relationship as reciprocal dynamism.Accordingly, this theoryisusedto influence behavior and personal characteristics in the environment(Najimi&Ghaffari, 2013). This can further explain that SCT is a framework that can be used to explain how an individual's behaviors are affected by their environment (Bandura, 2004).

Previousresearchers have established that physical activity participation rates declined at adolescent ageparticularly in adolescent girls who were mostly in low socioeconomic class (Brodersen, Steptoe, Boniface, & Wardle, 2007; Nader, Bradley, Houts, McRitchie, &O'Brien, 2008). The need in this situation is to improve physical activity behavior in the adolescent age group and this has informed some researchers to adopt SCTin identifying the roles of psychological and social factors that can influence physical activity behavior in the adolescents (Hagger, 2009). SCT is often used to design physical activity and nutrition education programs, especially for obesity prevention in children and young adults.

SCT was used in a systemic review study conducted by Bagherniya et al. (2017) that showed weak evidence in SCT based interventions for obesity control among adolescents. This has led to a suggestion of a future studies that use strategies of effective behavior change, more robust designs, larger sample size, and better measurement tools for conclusive judgement (Bagherniya et al., 2017). These researchers recommended a study with larger sample size (Bagherniya et al., 2017) for the use of SCT. Rolling and Hong (2016) used SCTto examine how environmental, cognitive, and behavioral factors interact to influence children's dietary conduct with respect to food and healthy lifestyle choices. The researchers recommended future research that better controls for confounding variables in order to determine the individual factors that can change the nutritional behavior.

Dewar et al. (2013) conducted research testing SCT to explain physical activity change in adolescent girls from low-income communities, aiming to assess the structural pathways ofSCTrelated toadolescent girls' physical activity and diet in order to prevent obesity. The result showed a fitting model however, only self-efficacy was found to be associated with physical activity and there was no support for intention or outcome expectations as determinants of behavior. Dewar et al. (20130recommended future research that may need integration of theoretical models such as ecological models.

Joseph, Ainsworth, Mathis, Hooker, and Keller (2017), in their qualitative research to examine the cultural relevance of SCT in the design of a physical activity intervention for African-American women, observed that participantswereunaware of the amount, intensity, and types of physical activity needed for health benefit in the construct of behavioral capability; while the construct of outcome expectations as related to physical activity tend to increase energy, improve health, reduce weight, and lead to positive role modelling behavior(Joseph et al., 2017). The constructs of self-efficacy and self-regulationwere barriers tophysical activity intervention and social support component is recommended for participants' behavior (Joseph et al., 2017). This result, however, is contrary to the findings of Dewar et al. (2013)who found that only self-efficacy was associated with physical activity and there was no support for intention or outcome expectations as determinants of behavior.

In a case study of an obese woman aged 48 years aiming to control eating and increase physical activity over a period of 4.4 years using social cognitive theory constructs, Annesi (2012) reported decrease in weight from 117.6 kg to 59.0 kg, and a decrease in body mass index (BMI) from 43.1 Kg/m². An initial decrease in average energy intake of 1792 kcal/day was recorded which subsequently dropped to 1453 kcal/day at the end of weight loss phase. Annesi (2012) further reported that use of constructs of self-efficacy, self-regulatory skills and overall mood significantly predicted increased physical activity and decreased energy food consumption. This finding is consistent with the findings of Dewar et al. (2013) above. Furthermore, Hamilton, Vayro, and Schwarzer (2015) examined the mechanism by which the social cognitive hypothesis is likely to predict fruit and vegetable consumption. They used 148 truck drivers as participants and assessed self-efficacy, outcome expectations, and intentions of the 148 participants.Their research finding was the role of outcome expectations and self-efficacy significantly predicted healthy eating intention among truck drivers. This result was consistent with the hypothesis ofSCT.

The assumptions from the reviewed articles that applied constructs of SCTwould enable me to understand, interpret, and explain the lifestyle factors and social determinants as predictors of weight and orBMI.Some of the constructs of SCT would provide a comprehensive theoretical framework for understanding the determinants of individual behaviors and could as well describe relevant procedures and mediators for behavioral change (Bandura, 1989, 1998, 2001, 2004). It is also clear that self-efficacy which is the most important of the constructs of SCT can be used as motivator of action, mediator, and basic requirement for behavioral change.

Obesity

Obesity is a measure of BMI and it is expressed mathematically as BMI $\geq$ 30 kg/m² and overweight as BMI $\geq$ 25kg/m² (Morgen & Sorensen, 2014).Globally, obesity affects 500 million people worldwide (World Health Statistics, 2008).This number is predicted to increase to 1 billion by the year 2030 (World Health Statistics, 2008).The prevalence of obesity is increasing, especially in nonendemic countries, and this has been attributed to some factors such as remarkable economic growth and some environmental factors like obesogenic environment (Popkin & Gordon-Larsen, 2004).However, theobesity pandemic is not restricted to advanced economies alone but is reported to be growing more quickly in emerging economies (Keats & Wiggins, 2014). In advanced industrialized countries, the prevalence of overweight and obesity, BMI $\geq$ 25kg/m² and BMI $\geq$ 30kg/m² respectively among men rose from 28.8% to 36.9% in the period of 1980 to 2013 respectively. Among women, the prevalence rose from 29.8% to 38.0% during the same period (Morgen & Sorensen, 2014). The rise in prevalence among boys and girls in developed countries during the same period was 16.9% to 23.8% and 16.2% to 22.6% respectively (Morgen & Sorensen, 2014). In developing nations, rise in prevalence of obesity was seen among children, adolescents, and adults (8.1% to 12.9%) but slower compare to those in advanced countries (Morgen & Sorensen, 2014). Morgen and Sorensen (2014) further reported that the overall prevalence of obesity was one-third of overweight and viewed this association as confirming the WHO report that overweight and obesity constitute one of the most important threats to global public health today (WHO, 2010).

Otang-Mbeng, Otunola, and Afolayan (2017) estimated the overall prevalence of obesity and overweight in South Africa at 38% and 19%, respectively. The researchers further reported that 70% of the prevalence of obesity was recorded among those who do not engage in any form of physical activity. Otang-Mbeng et al. (2017) further identified lack of physical activity, consumption of fried foods, and low fruit and vegetable diet as significant risk factors of obesity in South Africa and added that respondents who always consume fruits have obesity prevalence of 44.44%, those who never consume vegetable diet have obesity prevalence of 85.71%, and for those who always consume vegetable diet have obesity prevalence of 11.54%. This signifies that diets high in fruits and vegetables decrease the prevalence of obesity irrespective of age and gender.

Al-Qahtani (2019) estimated the prevalence of obesity and overweight among adults of kingdom of Saudi Arabia attending basic healthcare settings and reported the overall prevalence of overweight and obesity as 38.3% and 27. 6% respectively indicating high prevalence. This report is in line with the findings of Popkin, and Gordon-Larsen (2004). In developing countries, Schmeer (2010) reported a consisted and strong relationship between increasing risk of overweight/obesity and household income. This iscontrary to the research findings in developed countries. In another study conducted in Poland, people from low income were characterized by lowest physical activityand high prevalence of obesity; whereas women of medium income group and men of high income group were found to be most physically active group with decreased prevalence of obesity (Pciato et al., 2019) this finding is in conformity with the hypothesis of this study that physical activity, household income, income per capital and gender are predictors of weight/obesity.

Body Mass Index (BMI)

BMI is a measure of person's body size in a form of body weight in kilograms (kg) divided by the square of height in meters square (m^2). A high BMI indicates overweight or obesity. BMI is used to screen for overweight and obesity however, it is not diagnostic of the health problem of an individual. According to WHO, an adult with BMI $\geq$ 25 kg/m^2 is overweight, those with BMI $\geq$ 30 kg/m^2 are considered obese, BMI < 18.5 kg/m^2 is considered underweight, BMI between 18.5kg/m^2 and 24.9 kg/m^2 is considered healthy weight. This dissertation will mostly use BMI of 25 kg/m^2 and above as the outcome variable.

Schmeer (2010) in a study explored whether household income at various stages of childhood is related to weight status in young adulthood and suggested that abnormal BMI may have very high consequences for person's health. Further Researches have established strong relationship between BMI and household income. Rodriguez et al. (2019) conducted a research in Western United States that compares BMI of college students to national representative and also carryout BMI differences in parent funded (household income) versus self-funded college student and result was that average BMI and sample BMI distribution were significantly lower than that of national standard. Also,self-funded students were reported to have higher BMIs compared to parent-funded students (Rodriguez et al., 2019).The findings indicate that self-funded students are heavier young adults and are more likely to have less support from their parents and as such are less likely to be in college compared to the thin parent funded students. This study is in support of household income as a strong predictor of BMI.

Geographic Location and Obesity

Grant et al. (2018) have reported that geographic location plays a great role in influencing health outcomes in public health research. Emphasis has been made on geographic location as a predicting factor for childhood obesity in addition to other individual factors such as physical activity and diet. Grant et al. (2018) identified the following neighborhood factors: access to sources of food, access to recreational facilities, neighborhood safety and socioeconomic status as relevant to childhood obesity. Furthermore, in a comparative study conducted by Ahmed, Meyer, Kjollesdal, and Madar (2018) on the prevalence and predictors of overweight/obesity among Somalis in Norway and Somaliland, authors reported that in women in Norway, prevalence of obesity was 44% and for women in Somaliland was 31% indicating higher obesity prevalence among Somali women in Norway compare to their peers in Somaliland (Ahmed, Meyer, Kjollesdal, &Madar, 2018). The authors also reported a low prevalence of obesity in Norway men (9%) and 6% for men in Somaliland (Ahmed et al., 2018). This indicates that geographic location can be a good predictor of obesity as hypothesized in this Dissertation.

Adachi-Mejia et al. (2017)conducted a research study to examine whether relationship exists between neighborhood built environmental and BMI. The relationship was found to exist and varies by geographic information system data across the studied geographic zones (Northeast, Texas, and Washington) during the period of study. Physical activity was found to be significantly associated with lower BMI in the three geographic regions (Adachi-Mejia et al., 2017). The relationship between characteristics of the built environment and BMI showed variation across the geographic region even though some perceived and objectively measured characteristics of the built environment were significantly associated with adult BMI, relationships still varied by geographic region. Adachi-Mejia et al. (2017) suggest that regional variation plays a role in the relationship between adult BMI and built environment. According to Adachi-Mejia et al. (2017), major limitation of their study is inability to control for all possible confounders such as diet quality, built environment variables and failure to look at combined built environment factors (Adachi-Mejia et al., 2017).Utilitarian walking and other forms of physical activity were recommended for high BMI intervention regardless of geographic intervention (Adachi-Mejia et al., 2017). Also, future study to look at additional aspect of built environment related to outdoor recreation is recommended. Result of this study signifies that geographic location is a potential predictor of BMI.

Race and Obesity

It has been made clear that variations exist in prevalence of overweight and obesity within and among racial groups (Mui, Hill, & Thorpe, 2018). Race can, therefore, be a good predictor of overweight/obesity. In a study to examine overweight and obesity prevalence among ethnic subgroups of Asian American men and to compare to non-Hispanic White men, Mui, Hill, and Thorpe (2018) observed that prevalence of overweightwas higher among all Asian American subgroups compared to non-Hispanic

Whites, with the exception of Filipinos. No significant pair wise relationship among the Asian subgroups was found. However, this trend did not extend to obesity prevalence. Filipino men were the only subgroup that had higher chances of obesity than non-Hispanic Whites. Other identified Variations among subgroups were, Chinese men had minimal chances to be obese compared to all other Asian American subgroups, while Filipino men had more chances to be obese compare to all other subgroups. This aligns with the hypothesis that race can be a predictor of weight/obesity. Mui et al. (2018) identified the followings as limitations of their study: causality assumption cannot be made, Chances of misreporting from self-reported BMI related data.

Gillespie and Christian (2016) reported that in the United States obesity rates are high among African Americans and estimated that 49.6% of adult African Americans are obese. Gillespie and Christian (2016) in their study to examine racial differences in predicting maternal BMI for physiologic correlates of obesity, found that normal weighted European Americans had significantly lower BMI compare to their African American counterparts ($p < 0.01$), but no difference in mean BMI observed between overweight or obese European Americans and their African American counterparts. The results from such study demonstrated that ethnicity should be considered in interpreting BMI and it would be of great value to examine racial factor as a potential confounder in this research.

Education and Obesity

Researchers have established that educational attainment shows inverse relation to obesity. Having modified the relationship between educational attainment and obesity by gender and nation's economic development level, Cohen, Deandorrff, and Abrahams (2012) reported more common inverse association between education attainment and obesity in studies of higher income nations; and the studies of lower income countries revealed positive association between educational attainment and obesity after controlling for potential confounders. Cohen et al. (2012) further reported that Blacks who aspired to graduate from college stand more chances of becoming obese than Blacks who aspired to graduate from high school and also reported no statistical association between obesity and educational expectations. This implies that in Black community, the higher the level of education, the less likelihood is the obesity.

Conversely, Cohen et al. (2012) suggested that in white population; those expected to graduate college have lower chances to become obese compared to those who were expected to graduate high school or high school dropout. This implies that within countries, the association between educational attainment and obesity often appears to differ by gender and race (Cohen, Deandorrff, & Abrahams, 2012). This is in line with the findings of Yu (2012) that there is an increase in obesity among younger women who only attended college and decrease for younger white men without a high college degree.It is clear that education is one of the determinants of obesity and the relationship between educational attainment and obesity is likely to be confounded by a number of variables, Cohen et al. (2012) recommend the inclusion of these confounding variables such as gender, race, household income, age, and employment status in their future studies to better understand the non-confounded relationship between educational attainment and obesity. This recommendation is aligned with the hypothesis of this dissertation.

Furthermore, in another study conducted in Japan that aimed to examine how the association between education and overweight differs by marital status; and to determine the contribution of husband’s education to community dwelling Japanese women’s overweight/obesity (Murakami, Ohkubo, & Hashimoto, 2017). It was found that there was a significant association between women’s own education and unmarried women’s overweight/obesity and husband’s education was significantly associated with married women’s overweight/obesity (Murakami et al., 2017). This relationship was said to depend on educational attainment, as such there is variation in the relationship between women’s own education and overweight/obesity by marital status (Murakami et al., 2017).This signifies that social determinants (education and marital status) predict overweight and obesity.

In another study conducted by Muthuri et al. (2016) on relationships between parental education and overweight with childhood overweight and physical activity, found a positive association between parental overweight and child overweight. It was reported that in Colombian study a positive association between maternal education and child overweight was found; a negative association between paternal education and child overweight in Brazil; and a negative relationship between parental education and child physical activity in developing nations (Muthuri et al., 2016). This implies that the relationships between parental education and child's weight status and physical activity depends on the country's economy and household income.

Employment and Obesity

Nowadays in the United States of America adverse health and economic consequences have given rise to high prevalence of obesity (Wang et al., 2011). Obesity rate is on increase among United States adults. Park, Pan, and Lankford (2014) reported that 3 out of 10 employees in their United States study were obese and 6 out of 10 were either obese or overweight.Flegal, Carrol, Kit,and Ogden (2012) reported that about 36% of United States adults who are the majority in workforce at the age of 20 years and above were classified as obese. Work conditions and work environment are likely to influence weight related behaviors among employees who spend most of their time at workplace (Choi et al., 2010). In a study that examined relationship between employment characteristics and obesity, Park et al. (2014) reported that 28% of adults employed were obese and chances of being obese was significantly more among adults who worked in mid-sizecompany with employee capacity of 100 to 499and also employees whose weekly work output is more than 50 hours/week.

Generally, underweight and overweight associations are commonly seen in men who are longer-term jobseekers and jobseekers that are from lower income households. Hughes and Kumari (2017) advocated that unemployment is associated with underweight and showed that the unemployment and obesity relationship can only be properly studied if there is no assumption of unidirectional effects and further suggested that health of different groups may be affected through divergent adiposity mediated pathways. This study indicates that employment status is a social determinant of obesity.

Marital Status and Obesity

In the developed Western World, there is a consistency in association between education and obesity among women. Murakami, Ohkubo, and Hashimoto (2017) in their Japan study aiming to examine how the association between education and overweight/obesity by marital status differs, found that prevalence of overweight/obesity among unmarried women was higher than that of the married women (11.9% and 10.3%) respectively. The researchers further reported the existence of variation by marital status in the relationship between women's own education and overweight/obesity (Murakami, Ohkubo, & Hashimoto, 2017). The result, therefore, implies that there was a positive significant relationship between women's own education and overweight/obesity exceptionally, among unmarried women. These findings align with the hypothesis of this dissertation that marital status as a social determinant can predict weight/obesity.

Researchers have also established that obesity is more common among children of divorced parents, given that the prevalence of general overweight/obesity was 1.54 (95% CI 1.21 to 1.95) times more prevalent among children of divorced parents compared to children of married couples and further reported that both general and abdominal obesities were more prevalent among children of divorced parents (Biehl et al., 2014). A significant relationship has been reported between family structure and childhood overweight/obesity, suggesting that living with either one parent or divorced parents predict childhood overweight/obesity (Byrneet al., 2011). In a study conducted in

Norway among other similar studies conducted in industrialized western nations experiencing sociodemographic changes especially in the increase in number of divorced parents showed increase prevalence of childhood obesity (Biehl et al., 2014). The identified limitations by the authors were: Limited data on parental marital status, no basis for studying causality because of the cross-sectional nature of the design and problems of under-representation of participants (Biehl et al., 2014). Researchers recommended more detailed information on parental marital status to benefit the study outcomes (Biehl et al., 2014).

Age and Obesity

The CDC (n.d.) reported that young adults between the ages of 20 and 39 has 35.7% prevalence of obesity, middle aged adults between the ages of 40 and 59 years have 42.8% prevalence of obesity, and elderly people aged 60 years and above have 41.0% prevalence of obesity. This has shown a strong association between age and obesity indicating higher prevalence of obesity among middle aged adults and elderly people. In another study, researchers have reported that prevalence of overweight and obesity is age and sex dependent (Peralta, Ramos, Lipert, Martins, & Marques, 2018). High prevalence of overweight and obesity has been demonstrated amongst the elderly European population and also the epidemic proportions of high prevalence of obesity amongst older European adults (Age ≥ 50 years), (Peralta et al., 2018). In the recent European study to provide latest data on the prevalence and trends of overweight/obesity of older adults (age ≥ 50 years) from 2005 to 2013 in 10 different European countries, prevalence of overweight was above 60% and was stable over a period of 8 years i.e.

2005 -2013 (Peralta et al., 2018). This finding signifies that in any of the studied European countries, more than half of the older adults (age ≥ 50 years) were obese. This study aligns with the hypothesis of this Dissertation that age is a predictor of weight/BMI.

In another study establishing a strong relationship between age and obesity, Kranjac and Wagmiller (2016) found that between year 2011 and 2012 obesity rate was lower compare to between year 2003 and 2004 because during the period between 2003 and 2004 obesity was found to be strongly and positively associated with age and indicated that older children were more likely to be obese compared to younger children which was attributable to changes overtime in the population composition of children.

Physical Activity and Obesity

Researchers have reported that increasing physical activity among other factors predicting obesity such as diets, and sustainability of changes involving diets and physical activity can reduce overweight and obesity (Makambi& Adams-Campbell, 2017). An association of education and physical activity was also reported, indicating that well educated individuals are more likely to engage in physical activity, particularly women (Makambi& Adams-Campbell, 2017). Researchers in their case-control study in Washington DC aiming to assess the indirect relationship between sociodemographic factors and obesity, found a decrease of 7% in level of obesity for every one level of increase in education through its effect on vigorous physical activity (Makambi& Adams-Campbell, 2017). It can be deduced that if the relationship between age and obesity is mediated by physical activity, there is a positive indirect effect on obesity with level of obesity increasing by approximately, 6% for every one year increase in age through its effect on vigorous physical activity (Makambi& Adams-Campbell, 2017).

Conversely, provisions of physical activity facilities are obtainable from the environment resulting to lowering body mass index (BMI) and risk of being overweight/obesity (Hobbs, Griffiths, Green, Christensen, & McKenna, 2019). In a study conducted in Yorkshire, aiming to examine if really changes in BMI and obesity is related to the availability of physical activity facilities and parks and to find if the relationship differed by the age of participants (Hobbs et al., 2019). The result was that when the relationship differed by age, statistical interactions were found for physical activity facilities, parks and change in obesity by age. These findings suggested that the interaction by physical activity aligns with the hypothesis of this dissertation as a predictor of overweight/obesity.

Furthermore, in a prospective study aiming to determine an association of leisure time physical activity (LTPA) with BMI, waist circumference (WC) and the incidence of obesity (Fuentes et al., 2018). The result revealed an inverse association of total LTPA with BMI and WC; an inverse relationship of low intensity LTPA with BMI only; and an inverse relationship of moderate to vigorous LTPA with BMI and WC. Generally, the result therefore, established an inverse relationship of LTPA with BMI, WC, and an incidence of general obesity (Fuentes et al., 2018). This result implies that for a stronger inverse relationship of LTPA with BMI, WC, and incidence of general obesity, the intensity of LTPA must be moderate to vigorous. The inverse relationship nature of this study is in conformity with the findings of Makambi and Adams-Campbell (2017) above as stated “found a decrease of 7% in level of obesity for everyone level of increase in education through its effect on vigorous physical activity.

In another study aiming to determine the varying patterns of physical activity, sedentary behavior, and nutrition intake as individual predictors; and how the patterns of these predictors relate to youth’s demographics, Body mass index (BMI) and psychosocial functioning (Berlin et al., 2017), showed that children and adolescents who frequently engage in vigorous physical activity and less frequently engage in sedentary activities as it is used to be in watching television and playing video games have lower chances to be overweight and obese (Berlin et al., 2017). This implies that vigorous physical activity is inversely associated with overweight/obesity. According to the authors, this study has limitations of self-reporting for behaviors of interest that might lead to unreliable result, dropout from the cohort study that might lead to ascertainment bias, and the cross-sectional design used can lead to precluded reciprocal determination between predictors and outcome variables (Berlin et al., 2017).

In another study to assess the relationship between the body mass index and sports and physical activities in a simple random sample of teenagers from mid-northeastern Poland, Glinkowska, and Glinkowski (2018) reported that lack of significant differences in the BMI and obesity/overweight is prevalent in both boys and girls. The researchers further demonstrated that the association between obesity and less physical activity in boys was statistically significant; and the high chances of overweight/obesity in inactive teenagers (Poland, Glinkowska, &Glinkowski, 2018). Researchers further suggested the importance of intervention in overweight/obesity programs (Poland et al.,2018). The study limitations according to the researchers were self-reported data that can cause inaccuracies of the result and the likelihood of Bias information from participants at school leaving out their parents (Poland et al., 2018). This result also aligns with the results of the previous studies on the inverse association between obesity and physical activity.

Household Income and Obesity

Researchers have demonstrated that the association between low income and obesity is relatively new, and further showed that since year 1990 the correlation between obesity rate and household income has grown steadily, from no correlation to a very strong correlation by 2016 (Bentley, Ormerod, & Ruck, 2018). Poor American people are reported to be disproportionately affected by obesity(Bentley et al., 2018). Above 33% of American adults whose annual earning is low (≤ $15,000) are obese; while 24.6% earning about $50,000 per year are likely not to be obese (Bentley et al., 2018). It has been reported that between years 2004 and 2013, there was only 1% increase in obesity in the 25 wealthiest United States counties compared to 10% increase in obesity among 25 poorest United States counties (Bentley et al., 2018). This however signifies that the relationship between household income and obesity is inverse relationship.

Furthermore, it is clear to note that in the advanced industrialized economies, despite 10 years of economic growth as stated above, obesity was found disproportionately affecting the poor and this is described as “poverty obesity paradox (Hruschka& Han, 2017). It is important to note that different pattern exist when the correlation between household income and obesity in Industrialized economies is compared to that of developing economies. Hruschka (2012) reported that the percentage of obese individuals in high income countries now correlates inversely with median household income and named this phenomenon a “reverse gradient” it is a reverse pattern of what is seen in developing nations, where higher income correlates with obesity. It is good to note that in industrialized economies, human behaviorecology is predictor of obesity in poor population, this is because humans have evolved behavioral rules that lead to excessive eating in rich environments in addition poorer people have more immediate risks and concerns than outweigh long-term mortality risk of being obese (Dittmann&Maner, 2017).

Moreover, in another study to investigate the association between childhood income and early adult weight in a developing nation where there is nutrition transition, Schmeer (2010) reported an inverse relationship between high prenatal income and early adulthood (at 21 years) weight; and a direct relationship between high childhood income and early adulthood (at 21 years) overweight/obesity irrespective of sex. This signifies that household income after birth has greater chances of overweight during early adulthood (Schmeer, 2010), but this finding is opposite of what is seen in the advanced industrialized economies and this aligns with the findings of Hruschka (2012).

There are many studies about the epidemic of obesity but the consistency on how fast obesity rises in lower or higher socioeconomic groups remains a gap in literature. In Germany, Hoebel et al. (2019) examined secular trends in the prevalence of obesity based on socioeconomic status and the outcomes of obesity inequalities among German adults (25-59 years). The result showed lowest prevalence of obesity among highest socioeconomic groups and increase in the prevalence of obesity was observed among low and medium socioeconomic groups, and in high socioeconomic groups such type of trend was not seen (Hoebel et al., 2019). Based on these findings, the researchers suggested the existence of a large obesity gap between highest and lowest socioeconomic groups which may have adverse health effect and inequalities in the population (Hoebel et al., 2019). According to the authors the strengths of the study was larger sample size and the use of standardized anthropometric BMI measurements; while the limitations were: the study is observational cross-sectional study and as such the causality between obesity and socioeconomic status cannot be stated, and the study considered only obesity status and not severity (Hoebel et al., 2019). Generally, the findings of this study align with the hypothesis of this Dissertation that household income is a predictor of weight/BMI.

Gender and Obesity

According to WHO (2010), gender is a range of characteristics, roles, and behavior patterns. Socially, and culturally, gender distinguishes women from men and relations of power between them. Manyhealth-related factors such as income, employment status, social determinants, built environments, health services, and education, affect gender (Hassan Zadeh et al., 2014). A significant relationship between gender and health/well-being throughout life was reported (Hassan Zadeh et al., 2014). Researchers have reported that even though gender inequality is declining worldwide, gender disparity in health still exists globally and industrialized advanced economies are not exceptions (Hippisley-Cox, Yates, Pringle, Coupland, & Hammersley, 2006). In a study aiming to examine national trends in both prevalence and socioeconomic inequalities of obesities measured by BMI and waist circumference according to gender and socioeconomic position (SEP) indicators, Yoo, Cho, andKhang (2010) reported a significant increase in overweight and abdominal obesity among Korean men ($p< 0.01$) but in women no significant increase in weight/obesity was found.

In another study that aimed to test for hypothesis that gender inequalities irrespective of time, play a significant role in the development of adulthood overweight and obesity. Pinto, Griep, and Rotenberg (2018) reported a greater prevalence of overweight in men and more prevalence of obesity among women. This finding is more specific compare to that of Korean study where increase in overweight and abdominal obesity among Koreans was significant only in men. However, Pinto et al. (2018) attributed the greater prevalence seen in men to insufficient time for personal care and leisure. Generally, the findings of both studies align with the hypothesis of this dissertation that gender is a predictor of weight/BMI. Further study to examine predictive ability of BMI to detect overweight/obesity as defined by dual energy x-ray absorptiometry (DXA)-derived body fat percent (BF%) in Canadian; children and youth demonstrated that the association between BMI and BF% varied between gender and ethnic groups/age (McConnel-Nzunga et al., 2018). BMI that is strong diagnostic marker of obesity, was found to be more strongly associated with BF% in boys compared to their girls' peer (McConnel-Nzunga et al., 2018).

Further study in China that aimed to assess the relationship between body mass index (BMI) and health-related quality of life (HRQOL), and to determine gender differences in BMI-HRQOL association among adults in China reported underweight prevalence of 3.2% and 5.3% among men and women respectively, and prevalence of overweight/obesity of 35.7% and 34.6% among men and women respectively (Zhang et al., 2019). The association between obesity and gender indicated that obesity was negatively and significantly associated with HRQOL, however, men showed positive and non-significant relationship (Zhang et al., 2019). Furthermore, regression model indicated that the difference seen between men and women was significant in gender by BMI interaction and henceforth the relationship between BMI and HRQOL showed difference by gender and this is referred to as ‘Obesity HRQOL Paradox’ (Zhang et al., 2019). This finding signifies that gender is an important factor that predicts weight/BMI.

Social Determinants and Obesity

Social determinants of obesity are the social and environmental factors that predict obesity. Social determinants can be upstream, midstream or downstream factors which are based on intervention to address inequalities (Lakerveld&Mackenbach, 2017). The upstream factors align with macro level that includes global forces and government policies and operate in physical, sociocultural, and economic environment, while midstream or downstream factors aligns with individual health behaviors (Lakerveld&Mackenbach, 2017). Socio-economic status and inequality are the most consistent social determinant of obesity (Lakerveld&Mackenbach, 2017). Furthermore, it is clear that too much consumption of foods containing high energy and lack of physical activity constitute main behavioral risk factors to develop obesity (Lakerveld&Mackenbach, 2017). The social determinants in this dissertation to be hypothesized are: Geographic location, race, marital status, education, employment, physical activity, household income, and dietary consumptions.

In a study to identify the social and environmental determinants that are most strongly associated with overweight and obesity among Brazilian school children, Guedes, Rocha, Silva, Carvalhal, and Coelho (2011) found that using the WHO standard of 2007 for age and gender, the prevalence of overweight/obesity among the school children was lower than that of the previous studies conducted between 1996 and 1997 in both the southeast and northeast Brazil and even that of the international studies such as that of north America. Guedes et al. (2011) identified high household income, higher parental education level, and dietary consumption at school among others as primary social and environmental determinants potentially contributing to the incidence of overweight/obesity in Brazilian school children. In another study conducted in Sweden, Koupil and Toivanen (2008) reported a decreasedmean BMI and prevalence of overweight and obesity among mothers with higher education and added that mother's BMI and smoking strongly predict sons' overweight and obesity; this however, signifies that maternal overweight and maternal smoking appeared to be the strongest determinants of sons' overweight.

Furthermore, in India, Anuradha et al. (2015), conducted a study to assess the prevalence of overweight and obesity and its relationship with social and environmental determinants among the adolescent school children. The researchers reported that parental educational level, household/family income, and child sleep duration were strongly and significantly associated with overweight. The details of the analysis are as follows: Parental educational level as a predictor of overweight (Mother: 1.570; 95% CI: 1.048-2.354); family/household income as predictor of overweight (OR = 1.529; 95% CI: 1.089-2.148); child sleep > 7hours/day as predictor of overweight (OR = 2.006; 95% CI: 1.194-3.371). This signifies that household income, parental educational level, dietary consumption, and sedentary lifestyle are strong predictors of weight/BMI and these align with the hypothesis of this dissertation.

Diet and Obesity

Obesity develops over a long time as a result of poor diet and lifestyle behaviors such as: consumption of huge amount of processed or fast food that contains high fat and sugar (Makris & Foster, 2011). It is therefore, clear that consumptions of diets that contains decreased saturated fat, decreased sugar contents, and high fruit and vegetable diet are inversely proportional to overweight and obesity and as such can be used in the prevention of obesity in adults' population (Makris & Foster, 2011). Some researchers have investigated a relationship between adherence to the dietary approaches to stop hypertension (DASH) diet, a healthy foods that contains fruit and vegetables, legumes and nuts, low in saturated fatty acids, low sodium, and non-refined carbohydrate to investigate) with food security and weight status in adult women (Tabibian et al., 2018), and found that food insecurity group has the highest proportion of overweight and obesity ($p = 0.006$), while the group of adherence to DASH diet has a lower prevalence of overweight and obesity ($p = 0.017$). An association was therefore, reported between adherence to the DASH diet with a reduced risk of overweight and obesity, based on BMI, in food secure and insecurewomen(Tabibian et al., 2018).

Researchers have established the relationship between dietary factors and overweight and obesity, given priority to the determination of specific dietary components such as macronutrients and dietary fiber(Duet al., 2010). Some dietary patterns made-up of red meat, whole milk dairy products, processed foods and grains, appeared to be positively associated with general and abdominal obesity (Naja et al., 2011). In the Brazilian study, Arruda et al. (2015)investigated whether dietary patterns are associated with excess weight and abdominal obesity among young adults (23–25 years), and reported that bar pattern was associated with higher prevalence of overweight and abdominal obesity; while the energy dense pattern was associated with lower prevalence of overweight (Arruda et al., 2015). Men who adhere to traditional pattern were found to have lower prevalence of overweight, however, no association was found among their women counterpart (Arruda et al., 2015) and no significant association seen between the healthy pattern and overweight/abdominal obesity. These findings summarily signify that the barpattern was associated with higher prevalence of overweight and abdominal obesity; while both theenergy-dense(for men & women) and traditional Brazilian patterns(for men) were associated with lower prevalence of overweight (Arruda et al., 2015). These findings are aligned with the hypothesis of this dissertation that diet is a predictor of obesity.

It is universally believed that consumption of breakfast/non consumption of breakfast, protects against overweight and obesity (Brown,Bohan Brown,& Allison, 2013). Based on this believe researchers have examined the relationships between the breakfast and the type of breakfast consumed with BMI and prevalence of overweight/obesity among Canadian adults and reported that even though there was a significantly lower BMI among consumers of ready to eat cereal (RTEC) breakfast than those who consumed other breakfast, there was still no consistent association between breakfast consumption with differences in BMI or overweight/obesity prevalence (Barr, Difrancesco, &Fulgoni, 2016).

Summary

This chapter discussed lifestyle factors and social determinants as predictors of weight/body mass index and the global burden of overweight and obesity. Overweight and obesity is the fourth leading risk factor of global mortality (Fialkoff& Kerner, 2019) and obesity is found everywhere in the world and is becoming more prevalent in countries where it was not a problem in the past (Lee, 2017). High fruits and vegetable diets are inversely proportional to overweight and obesity (Makris & Foster, 2011) and likewise increased physical activities are the main stay for overweight/obesity control.Reports from the review of the literature suggested either direct or inverse association between household income, respondent sex, social determinants of obesity, and diet and weight/BMI as well as between geographic location, race, age, marital status, education and employment status. In Chapter 3, I will discuss research design, data collection, and data analysis for this study.

Chapter 3: Research Method

The prevalence of obesity is on the rise, particularly in countries where it was rarely a burden (Lee, 2017). The prevalence of obesity was said to vary by social and cultural contexts and gender has been identified asan important social factor of obesity (Garawi, Devries, Thorogood,&Uauy, 2014). The purpose of this study was to determine the extent to which frequency of physical activity, household income, social determinants of health, respondent sex, and diets predict respondent weight/BMI in the United States,after controlling for potential confounders (geographic location, race, age, marital status, education, and employment).Themajor sections of this chapter include: the research design and rationale, methodology, target population, sampling and sampling procedures, procedure used in the collection of secondary data, operationalization of variables, data analysis plan, threats to validity, andethical procedures and how the ethical concerns were addressed.

Research Design and Rationale

The research design that was used for this study was a quantitative cross-sectional design in which data was collected at a specific point in time to determine the relationship between the predicting factors and health outcomes. Quantitative design is best applied to the research problem as it allows the researchers to examine the association between predicting variables and outcome variables (Rudestam& Newton, 2014).Quantitativedata was used to look for cause and effect relationships and as such it was used to make predictions. The quantitative design therefore aligned with the primary research question for this study, which was: To what extent do frequency of physical activity, household income, respondent sex, social determinants, and diet predict respondents' weight/BMI after controlling for geographic location, race, age, marital status, education, and employment? Furthermore, of interest at a specific point in time, and since itismore frequently dependent on data that was originally collected for another purpose, cross-sectional study has a very suitable connection with the research questions of this study that is using secondary data. There were no anticipated time or resource constraints associated with this design choice.

The independent variables for this study were frequency of physical activity, which is referred to any bodily movement, produced by skeletal muscles that require energy expenditure and are the key determinant of energy expenditure and are also fundamental to energy balance and weight/obesity control (WHO, n.d.); household income, which was referred to a measure of combined incomes of all people from 15 years of age and above living together in a particular household or place of residence irrespective of whether they are related or not and it includes every form of income, such as salaries/wages, and retirement income (Kagan, 2019);social determinants of obesity, which is a social and environmental factor that predict obesity mostly upstream that is based on intervention to address inequalities (Lakerveld&Mackenbach, 2017);respondent sex; and diet,whichwas referred to food and drink that is regularly consumed by people.while the dependent variable was respondent weight/obesity (BMI), a measure of BMIthat is expressed mathematically as BMI $\geq$ 30 kg/m² and overweight as BMI $\geq$ 25kg/m² (Morgen & Sorensen, 2014). The confounding variables weregeographic location, race, age, marital status, education, and employment.

A quantitative cross-sectional design can be useful in providing better public health planning for intervention, monitoring, and evaluation of the result outcomes from analyzeddata(Brener et al., 2013). Furthermore, in using this design on the secondary data to answer the research questions, the study was carried out within time and resource constraint which could effectively and efficiently promote knowledge of potential predictors of obesity and also help in public health obesity intervention program.

Methodology

Population

The target population for this study was adults living in households in all 50 U. S. States, the District of Columbia, Puerto Rico, the U.S. Virgin Islands, Guam, American Samoa, and Palau. TheCenter for Disease Control and Prevention (CDC), U. S. Department of Health and Human Services is the sponsor of the data collection, which was conducted annually starting from 1987 to the most recently conducted survey in the year 2017.The full datasetis available for all years through 2016. The target population size was approximately 486,303.

Sampling and Sampling Procedures

A representative sample of adults living in households in all 50 U. S. states, the District of Columbia, Puerto Rico, the U.S. Virgin Islands, Guam, American Samoa, and Palau will be obtained by using a probability sampling strategy (simple random sampling type) in whicha sample from a larger population was chosen based on the probability theory and participants are randomly selected. This sampling strategy was appropriate for this study as it allowed all persons to have a chance of being selected, and the obtained results were more likely to accurately reflect the entire population as it gives the best chance to create a sample that is true representative of the population (Sigh, 2015). The specific procedure employed for drawing the sample from the population was a computer-generated process method of simple random sampling, where each adult in the household was assigned a number after which adults were selected at random by computer. This selection provideda small random portion to represent the entire data set, where each member had equal probability of being chosen. The inclusion criteria for this study were: Adults, irrespective of gender, living in households in all 50 U. S. States, the District of Columbia, Puerto Rico, the U.S. Virgin Islands, Guam, American Samoa, and Palau, and must be citizens of these places.Children and adolescents will be excluded from this study. To determine sample size using power analysis, G*Power 3.1.9.2 software was used.Power calculation for a logistic regression was run at a statistical power level of 0.95 (95%), significance level was set at 0.05, and the effect size was 0.15 (Faul, Erdfelder, Buchner, & Lang, 2017). The minimum sample size calculated was 568. Smaller effect size of 0.15 was required to detect larger sample size; while higher statistical power detects larger sample size and they were appropriate for this study.

Data Collection

Iuseda secondary dataset for this research which is located ontheCDC Behavioral Risk Factor Surveillance System (BRFSS) website. The name of the dataset is ‘2017 BRFSS Data (ASCII).The dataset was originally collected by telephone (combined landline and cellular telephone) interviews, using BRFSS standard questionnaire, and strictly on BRFSS standard protocols for data collection.Thedataarepublicly and freely available through the CDC website and NCCOR catalogue of surveillance system (BRFSS). No permission is needed to access the dataset. The dataset contained all the predicting variables and outcomes variables that can answer my research questions.

Operationalization

The independent variables for this study were: physical activity, household income, and respondent sex,geographic location, race, age, marital status, education, diet, and social determinants, and employment. The dependent variable was weight/obesity body mass index (BMI). The operational definition and measures/manipulations of these variables are:

Weight is the numbers that appear when a participant is placed on a weight scale, mathematically symbolized as “Kg” and it is classifiedas a scale/ratio variable.
Obesity is defined as a measure of body mass index (BMI) and it is expressed mathematically as BMI $\geq$ 30 kg/m^2 and overweight as BMI $\geq$ 25kg/m^2 (Morgen &Sorensen, 2014)and was classified asa nominal variable.

Physical activity referred to any bodily movement, produced by skeletal muscles that require energy expenditure and are key determinant of energy expenditure and a key fundamental to energy balance and weight/obesity control (WHO, n.d.) and was measured as anominalvariable.Social determinants of health is defined as conditions or circumstances, in which people are born, grow, live, work, and age (World Health Organization, n.d.) and its condition is shaped by political, social, and economic forces such as money for balanced meals, and finances at the end of the month, and was classified as ordinal variables. Household income, defined as a measure of combined incomes of all people living together in a particular household or place of residence and it includes every form of income, such as salaries/wages, and retirement income (Kagan, 2019), was measured as an ordinal variable.Diet is food and drink that is regularly consumed by people. Consumptions of diets that contains high fruit and vegetable diet are inversely proportional to overweight and obesity and as such can be used in the prevention of obesity in the adult population (Makris & Foster, 2011); this wasclassifiedas an ordinal variable.

Gender is a distinction between male and female; it wasclassifiedas a nominal variable. Geographic location is a location on the earth in terms of another and is anominal variable. Race is grouping of people based on their physical and social characteristics distinct by society; it was classified as a nominal variable. Age is numbers of years passed following person’s date of birth and was measured in scale level. Marital status is an established relationship in terms of whether an individual forms a couple relationship with another person living in the same compound andwasclassifiedasanominalvariable.Educational attainment is the highest year of school completed reported for an individual in any field of study; this was classified as an ordinal variable. Employment status is classified as employed with wages or self-employed and is considered a nominal variable.

Table 1

Predictor and Outcome Variables

Variable Name	Variable Type	Question from the Survey to Collect	Possible Responses to the Questions
Physical Activity	Nominal	Do you engage in daily physical activity?	Yes = 1 No = 2
Household Income	Ordinal	What is the level of your household income?	High ($51,000-≥$75,000) = 1 Medium ($26,000-$50,000) = 2 Low ($10,000-25,000) = 3
Age of Respondent	Scale	What is your age?	Exact numerical age
Marital Status of Respondent	Nominal	What is your marital status?	Married = 1 Single = 2 Divorced = 3 Widowed = 4 Separated = 5
Race of Respondent	Nominal	You belong to which race or ethnicity?	White = 1 Black = 2 American Indian = 3 Asian = 4 Pacific Islander =5 Other =6
Sex of Respondent	Nominal	Gender?	Male =1 Female =2
Fruit Consumption	Ordinal	How often did you eat fruit?	Days = 1 Weeks = 2 Months =3 Never = 4
Fruit Juice Consumption	Ordinal	How often did you drink fruit juice?	Days = 1 Weeks = 2 Months = 3 Never = 4
Green vegetable/salad consumption	Ordinal	How often did you eat green vegetable?	Days = 1 Weeks = 2 Months = 3 Never = 4
Fried potatoes consumption	Ordinal	How often did you eat fried potatoes?	Days = 1 Weeks = 2

			Months = 3 Never = 4
Any other kind of potatoes Consumption	Ordinal	How often do you consume other forms of potatoes?	Days = 1 Weeks = 2 Months = 3 Never =4
Weight	Scale	What is your weight?	e.g. 79 Kg, 90 Kg etc
Height	Scale	What is your height?	e.g. 1.5 m, 1.79 m etc
Obesity	Nominal	Will be calculated	$\geq$ 30 Kg/m² = 1 < 30 Kg/m² = 2
Employment Status	Nominal	What is your employment status	Employed with wages = 1 Self-employed = 2 Not employed = 3
Educational Level	Ordinal	What is your educational level?	None = 1 Elementary = 2 High School = 3 College = 4
Geographic location	Nominal	Where do you live?	50 US States =1 District of Columbia = 2 Puerto Rico = 3 US Virgin Islands = 4 Guam = 5 American Sam. = 6 Palau = 7
Poor Mental Health	Nominal	Any difficulty in concentration,or remembering, or making discussion?	Yes = 1 No = 2
Finances at month ending	Ordinal	How do your finances usually work out at the end of the month?	End up with some money = 1 Just enough money = 2. Not enough money = 3.
Money for balanced meal.	Ordinal	How often could you not afford balanced diet?	Often = 1 Sometimes = 2 Never true = 3

Data Analysis Plan

The software used for the data analyses was the IBM Statistical Package for the Social Sciences (SPSS) Statistics, version 24. Secondary data was used for this research. Data cleaning and screening procedures were carried out by the trained primary researchers. Only the relevant variables to my research questions were analyzed.

The research questions and the specific hypothesis that guided this study were:

Research Question 1 (RQ 1):To what extent do frequency of physical activity, household income, and respondent sex predict respondents' weight/BMI after controlling for geographic location, race, age, marital status, education, and employment?

Null Hypothesis ($H_0$1):Frequency of physical activity, household income, and respondent sex do not predict respondents' weight/BMI after controlling for geographic location, race, age, marital status, education, and employment.

Alternative Hypothesis ($H_1$1):Frequency of physical activity, household income, and respondent sex do predict respondents' weight/BMI after controlling for geographic location, race, age, marital status, education, and employment.

Research Question 2 (RQ 2):To what extent do social determinants of health (money for balanced meals, finances at the end of month, and poor mental health), household income, and respondent sex predict respondents' weight/BMI after controlling for geographic location, race, age, marital status, education, and employment?

Null Hypothesis ($H_0$2):Social determinants of health (money for balanced meals, finances at the end of month, and poor mental health), household income, and respondent sex do not predict respondents' weight/BMI after controlling for geographic location, race, age, marital status, education, and employment.

Alternative Hypothesis ($H_1 2$) :Social determinants of health (money for balanced meals, finances at the end of month, and poor mental health), household income, and respondent sex do predict respondents' weight/BMI after controlling for geographic location, race, age, marital status, education, and employment.

Research Question 3 (RQ 3): To what extent do diet (fruit, fruit juice, potato, and dark green vegetable consumption), household income, and respondent sex predict respondents' weight/BMI after controlling for geographic location, race, age, marital status, education, and employment?

Null Hypothesis ($H_0 3$): Diet (fruit, fruit juice, potato, and dark green vegetable consumption), household income, and respondent sex do not predict respondents' weight/BMI after controlling for geographic location, race, age, marital status, education, and employment.

Alternative Hypothesis ($H_1 3$): Diet (fruit, fruit juice, potato, and dark green vegetable consumption), household income, and respondent sex predict respondents' weight/BMI after controlling for geographic location, race, age, marital status, education, and employment.

The dependent variable "weight/obesity (BMI)" was transformed to a dichotomous (binary) variable and I used binary logistic regression to examine the association between the independent (predicting) variables and dependent (dichotomous) variables for each research question and their specific hypothesis.This test wasappropriate because it was used to test the relationship between a dependent dichotomous variable and one or more nominal, ordinal, interval/ratio level independent variables.Binary logistic regression was used to compute the associations between the independent and dependent variables. When the association between the dependent and independent variables was at analpha level of $p \leq 0.05$, the association was deemed statistically significant. Beta values was used to measure the direction of the association between the dependent and independent variables, and the estimate of the outcome predicted by the independent variables was given in the model. The covariates also referred to as confounders were categorized among independent variables and the rationale for their inclusion in a model was because of their potential to increase accuracy of the study results which was detected by their likelihood ratio tests and the measurement of Wald statistics that contribute to detection of their effects on the model (Field, 2013).

Hirpara, Jain, Gupta, and Intern (2015) identified that statistical results based solely on the *p*-value could be misleading and suggested the use of confidence intervals that provides a range of true observed effect in a study which would lie 95% or 90% of the time.A confidence interval (CI) of 95% indicates a 95% chance that range contains the true population mean. The width of the CI predicted sample size; narrow width indicated small range of effect size and hence larger sample size. However, an odds ratio of 1.8 of the association between the independent variables and dependent variable was interpreted as: Independent variables have 80% likelihood to predict obesity (the outcome variable). A probability value of $p \leq 0.05$ strongly indicated evidence to reject the null hypothesis.

Threats to Validity

Research findings evaluation depended on internal and external validity(Frankfort-Nachimias&Nachimias, 2015). External validity is described as extent to which results of a study can be generalized to the world at large and also addresses the applicability of the study findings to other studies (Frankfort-Nachimias&Nachimias, 2015); internal validity is concerned with causal association between the independent and dependent variables, and randomized studies with less confounding variables having higher internal validity (Frankfort-Nachimias&Nachimias, 2015). There were three threats of internal validity identified as appropriate to this study and they are: selection-maturation, interaction, and regression. Selection which was addressed by using probability sampling in the form of simple random sampling. The randomization ensured higher internal validity. Interaction was addressed by controlling for the potential confounding variables (geographic location, race, age, marital status, education, and employment) during the hypothesis testing. Regression threat was addressed by using binary logistic regression test to examine the association between the independent (predicting) variables and dependent (dichotomous) variables for each research question and their specific hypothesis.

Ethical Procedures

I used secondary de-identified data from the BRFSS obtained from CDC website. The Walden University Institutional Review Board (IRB)granted approval (IRB# 01-29-20-0646245) to conduct mystudy.I stored the data on a password protected laptop and will keep the data encrypted for 5 yearsat which time it would be destroyed. I will be the only person who will have access to the data.

Summary

Researchers have documented that obesity is a major health concern that includes the risks of developing cardiovascular disease (CVD) and preventable premature death in adults (Umer et al., 2017). This research was therefore, conducted to determine the extent to which frequency of physical activity, household income, social determinants of health, respondent sex, and diets predict respondent weight/BMI in the United States of America, after controlling for potential confounders (geographic location, race, age, marital status, education, and employment).Binary logistic regression was used to analyze the data for this quantitative cross-sectional study. Chapter 4includeddetailed data analysis and the results of the study.

Chapter 4: Results

The purpose of this cross-sectional quantitative study was to determine the extent to which frequency of physical activity, household income, social determinants of health, respondent sex, and diets predict respondent weight/BMI in the United States of America, after controlling for potential confounders (geographic location, race, age, marital status, education, and employment). This study was guided by the following research questions and hypotheses.

Research Question 1 (RQ 1):To what extent do frequency of physical activity, household income, and respondent sex predict respondents' weight/BMI after controlling for geographic location, race, age, marital status, education, and employment?

Null Hypothesis ($H_0$1):Frequency of physical activity, household income, and respondent sex do not predict respondents' weight/BMI after controlling for geographic location, race, age, marital status, education, and employment.

Alternative Hypothesis ($H_1$1):Frequency of physical activity, household income, and respondent sex do predict respondents' weight/BMI after controlling for geographic location, race, age, marital status, education, and employment.

Research Question 2 (RQ 2):To what extent do social determinants of health (money for balanced meals, finances at the end of month, and poor mental health), household income, and respondent sex predict respondents' weight/BMI after controlling for geographic location, race, age, marital status, education, and employment?

Null Hypothesis ($H_0$2):Social determinants of health (money for balanced meals, finances at the end of month, and poor mental health), household income, and respondent sex do not predict respondents' weight/BMI after controlling for geographic location, race, age, marital status, education, and employment.

Alternative Hypothesis ($H_1$2):Social determinants of health (money for balanced meals, finances at the end of month, and poor mental health), household income, and respondent sex do predict respondents' weight/BMI after controlling for geographic location, race, age, marital status, education, and employment.

Research Question 3 (RQ 3): To what extent do diet (fruit, fruit juice, potato, and dark green vegetable consumption), household income, and respondent sex predict respondents' weight/BMI after controlling for geographic location, race, age, marital status, education, and employment?

Null Hypothesis ($H_0$3): Diet (fruit, fruit juice, potato, and dark green vegetable consumption), household income, and respondent sex do not predict respondents' weight/BMI after controlling for geographic location, race, age, marital status, education, and employment.

Alternative Hypothesis ($H_1$3): Diet (fruit, fruit juice, potato, and dark green vegetable consumption), household income, and respondent sex predict respondents' weight/BMI after controlling for geographic location, race, age, marital status, education, and employment.

In this chapter, I will provide the results of the statistical analysis for this study.

Data Collection

The 2017 BRFSS secondary dataset was used for this research.The dataset was originally collected by telephone (combined landline and cellular telephone) interviews, using BRFSS standard questionnaires and strictly following BRFSS standard protocols fordatacollection.The data is publicly and freely available through the CDC website and NCCOR catalogue of surveillance system (BRFSS). No permission was needed to access the dataset. A total of 568 participants were randomly selected from the larger sample size of the dataset. Descriptive statistics of demographic variables used in this study were provided.

Marital status was an independent, categorical, and confounding variable measured onan ordinal level. Most respondents were married 298 (52.5%), followed by those who have never married 98 (17.3%). The divorced and widowed were 85 (15.0%) and 57 (10.0%) respectively. The separated and member of unmarried couples were the least in the group and they constituted 14 (2.5%) and 13 (2.3%) respectively (see Table 2).

Table 2

Marital Status

	Frequency	Percent
Married	298	52.5
Divorced	85	15.0
Widowed	57	10.0
Separated	14	2.5
Never married	98	17.3
A member of an unmarried couple	13	2.3
Refused	3	.5
Total	568	100.0

Employment status was also an independent, categorical, and confounding variable that was measured on an ordinal scale. the number of respondents who were employed for wages stood at 240 (42.3%); 141 (24.8%) were retired from active service. Those who were self-employed and unable to work were 53 (9.3%) and 51 (9.0%) respectively. The smallest groupin the datasetwere either out of work for 1 year or a student, at 20 (3.5%) and 18 (3.2%) respectively (see Table 3).

Table 3

Employment Status

	Frequency	Percent
Employed for wages	240	42.3
Self-employed	53	9.3
Out of work for 1 year or more	20	3.5
Out of work for less than 1 year	11	1.9
A Homemaker	32	5.6
A Student	18	3.2
Retired, or	141	24.8
Unable to work	51	9.0
Refused	2	.4
Total	568	100.0

Educational level was an independent, categorical, and confounding variable. Most of the respondents (215, or 37.9%) were college graduate followed by some college or technical school (158, or 27.8%) andthose who were graduate of high school(149, or 26.2%). Very few respondents attended elementary school, and some high school, 20 or 3.5% and 23 or 4.0% respectively. Only one respondent did not attend school at all 1 or 0.2% and 2 or 0.4% respondents refused to answer this question.

Table 4

Educational Level

	Frequency	Percent
None	1	.2
Elementary	20	3.5
Some high school	23	4.0
High school graduate	149	26.2
Some college or technical school	158	27.8
College graduate	215	37.9
Refused	2	.4
Total	568	100.0

Race/ethnicity was an independent, categorical, and confounding variable. The majority of the respondents were Caucasian416 or 73.2%, followed by African Americans and Japanese each 48 or 8.5%. Asian and Filipino were 20 or 3.5% and 15 or 2.6% respectively. American Indian was 11 or 1.9%. Asian Indian, Chinese, and Korean were 3 or 0.5%, 1 or 0.2%, and 6 or 1.1% respectively.

Table 5

Race/Ethnicity

	Frequency	Percent
White	416	73.2
Black or African American	48	8.5
American Indian or Alaska Native	11	1.9
Asian	20	3.5
Asian Indian	3	.5
Chinese	1	.2
Filipino	15	2.6
Japanese	48	8.5
Korean	6	1.1
Total	568	100.0

Respondent sex included 246 male participants and 322 female participants. Womenwere 76 or 13.4% higher in frequency compared to men(see Table 6).

Table 6

Respondents Sex

	Frequency	Percent
Male	246	43.3
Female	322	56.7
Total	568	100.0

For household income, most participants earned $75,000 and more per annum, 144 or 25.6%, and very few earned less than $15,000 per annum, 25 or 4.4%.

Table 7

Income Level

		Frequency	Percent
	Less than $10,000	25	4.4
	$10,000 to less than $15,000	25	4.4
	$15,000 to less than $20,000	37	6.5
	$20,000 to less than $25,000	48	8.5
	$25,000 to less than $35,000	42	7.4
	$35,000 to less than $50,000	62	10.9
	$50,000 to less than $75,000	85	15.0
	$75,000 or More	144	25.4
	Don’t know / Not sure	45	7.9
	Refused	50	8.8
	Total	563	99.1
Missing	System	5	.9
Total		568	100.0

Results

The software used for the data analyses for this research was SPSS, version 24.Descriptive statistics were provided for independent and dependent variables.

BMI was the dependent dichotomous variable with two categories (not obese & obese). The frequency of not obese participants was 373 (65.7%) and that of the obese participants was 195 (34.3%).

Table 8

Body Mass Index

	Frequency	Percent
Not Obese	373	65.7
Obese	195	34.3
Total	568	100.0

The number of participants whohad physical activity in the past 30 days was 363 (69.1%) and the number of participants whohad no physical activity in the past 30 days was161 (30.7%). One participant responded not knowing. This indicated that most of the participants (69.1%) in this study had physical activity in the past 30 days.

Table 9

Physical Activity in Past 30 Days

		Frequency	Percent
	Yes	363	63.9
	No	161	28.3
	Don’t know	1	.2
	Total	525	92.4
	Missing	43	7.6
Total		568	100.0

The valid value of no money for balanced meals from the sample was 119 or 21%. The missing value was 449 or 79%. From the valid responses, most of the participants did not agree that they don’t have money for balanced meals 103 or 86.6%, only few agree that they do not often have money for balanced meals 5 or 4.2%, and 10 or 8.4% of the participants agree that they do not have money for balanced meals.

Table 10

No Money for Balanced Meals

		Frequency	Percent
	Often true	5	.9
	Sometimes true	10	1.8
	Never true	103	18.1
	Don't Know	1	.2
	Total	119	21.0
	Missing	449	79.0
Total		568	100.0

The variable, "how do your finances usually work out at the end of the month" has valid responses of 119 or 21% and missing values of 449 or 79%. However, from the valid responses, most of the participants end up with some money left over at the end of the month 54 or 45%. About the same proportion of the participants have just enough money to make ends meet (42%). Only few participants do not have enough money to make ends meet 11 or 9.2%. Two participants (1.7%) each either refused to answer this question or claimed not to know.

Table 11

How Do Your Finances Usually Work Out

		Frequency	Percent
	End up with some money left over	54	9.5
	Have just enough money to make ends meet	50	8.8
	Not have enough money to make ends meet	11	1.9
	Don’t Know	2	.4
	Refused	2	.4
	Total	119	21.0
	Missing	449	79.0
Total		568	100.0

Most of the participants have not experienced any form of poor mental health at any time 368 (64.8%). Those that experienced poor mental health a little of the time were 116 (20.4%), and only very few participants 75 (13.2%) experienced poor mental health some of the time.

Table 12

PoorMental Health

	Frequency	Percent
None of the time	368	64.8
A little of the time	116	20.4
Some of the time	75	13.2
9	9	1.6
Total	568	100.0

Fruit juice intake in times per day has a valid value of 523 (92%) and mean statistics and standard deviation of 27.8 and ±48.3. Fruit intake in times per day has a valid value of 516 (90.8%), mean statistics and standard deviation were 112.9 and ±106.3. Computed potato servings per day has a valid value of 520 (91.5%), mean statistics and standard deviation were 23.2 and ±35.7; while dark green vegetable intake in a day has a valid value of 526 (92.6%) with mean statistics and standard deviation of 56.1 and ±54.2 respectively (see Table 13).

Table 15

Descriptive Statistics of Fruit and Vegetable Intake

	N	Minimum	Maximum	Mean		Std. Deviation	Variance
				Statistic	Std. Error		
Computed fruit juice intake in times per day	523	0	400	27.78	2.110	48.260	2329.016
Computed fruit intake in times per day	516	0	700	112.93	4.680	106.311	11302.129
Computed potato servings per day	520	0	500	25.22	1.565	35.686	1273.501
Computed dark green vegetable Intake in a day	526	0	700	56.07	2.362	54.182	2935.655
Valid N (listwise)	499						

Binary logistic regression was used to analyse the data and this requires assumptions to give a valid result. This statistical test was appropriate for this study because most of the required assumptions were met as follows. The dependent variable

(BMI) was measured on a dichotomous scale (obese and not obese) and this satisfied the assumption number 1. This study has more than one independent variable that was made up of both continuous and categorical variables such as physical activity, household income (measured in ordinal), respondent sex measured at nominal level, money for balanced meals (measured in scale), finances at the end of the month (measured on scale), poor mental health (measured in ordinal) and diet consumptions (measured in scale), and this has satisfied the assumption number 2. The sample size of 568 participants was large enough to have satisfied the assumption number 3. Moreover, the dichotomous nature of the dependent variable 'weight/BMI' (obese or not obese) has provided mutually exclusive and exhaustive categories and stands better to provide independence of observations to meet up with this assumption of binary logistic regression.

Binary logistic regression was used to answer the following research questions.

Research Question 1 (RQ 1): To what extent do frequency of physical activity, household income, and respondent sex predict respondents' weight/BMI after controlling for geographic location, race, age, marital status, education, and employment?

Null Hypothesis ($H_0 1$): Frequency of physical activity, household income, and respondent sex do not predict respondents' weight/BMI after controlling for geographic location, race, age, marital status, education, and employment.

Alternative Hypothesis ($H_1 1$): Frequency of physical activity, household income, and respondent sex do predict respondents' weight/BMI after controlling for geographic location, race, age, marital status, education, and employment.

I conducted a binary logistic regression analysis to determine the association between the predictor variables and outcome variable. The predictor variables for the binary logistic regression were frequency of physical activity, household income, and respondent sex. The outcome variable was weight/BMI and confounding variables were geographic location, race, age, marital status, education, and employment.

Table 16 shows a statistically significant model ($p< 0.005$) and a good model fit. Table 17 explains variation in the dependent variable that ranges from 12.0% to 16.6%. Since Nagelkerke R^2 cannot achieve a value of 1, Negelkerke R^2 value was preferably reported. Table 18 is Hosmer and Lemeshow's test which is another Chi square test and was not statistically significant for the model. Table 19 is a classification table that has a probability cut off value of 0.5 indicating that the estimated probability of obesity occurring is greater than or equal to 0.5; while if the probability is less than 0.5, the event is classified as not obese. Table 20 is variables in equation that show the contribution made by every independent variable to the model and its statistical significance. The result shows household income ≥ \$75, 000/annum ($p = 0.009$,95%CI = 1.38, 10.10), and Black race/African American ($p = 0.031$, 95% CI = 1.11, 8.90) added significantly to the model/prediction. This indicates a statistically significant relationship between household income level and weight/BMI, similarly, there was a statistically significant relationship between respondent's race and weight/BMI. Hence, the null hypothesis is rejected and the answer to the research question 1 is 'household income and respondent's race do predict respondents weight/BMI after controlling for geographic location, age, marital status, education, and employment'. However, every other independent variable including confounding variables were not statistically significant and did not add significantly to the model.

Binary logistic regression was performed to determine the predicting effects of frequency of physical activity, household income, and respondent sex on the likelihood of being obese or not obese after controlling for geographic location, race, age, marital status, education, and employment. The binary logistic regression was statistically significant (*p*< 0.005). The model explained 16.6% (Negelkerke R^2) of variance in obese and has correctly classified 70.5% of obese cases. Increase in one unit of household income level ≥ $75,000/annum has 3.7 times more likely to be obese than every other household income level. Similarly, an increase in one of Black race/African American has 3.15 times more likelihood of becoming obese.

Table 16

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	65.984	38	.003
	Block	65.984	38	.003
	Model	65.984	38	.003

Table 17

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	593.637[a]	.120	.166

a. Estimation terminated at iteration number 20 because maximum iterations has been reached. Final solution cannot be found.

Table 18

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	4.632	8	.796

Table 19

Classification Table[a]

			Predicted		
			Body Mass Index		Percentage
	Observed		Not Obese	Obese	Correct
Step 1	Body Mass Index	Not Obese	314	28	91.8
		Obese	124	50	28.7
	Overall Percentage				70.5

a. The cut off value is .500

Table 20

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	Exercise in Past 30 days(1)	-.157	.232	.454	1	.500	.855	.542	1.348
	Income level			16.060	9	.066			
	Dont know	.479	.618	.603	1	.437	1.615	.482	5.418
	Less than $10,000	-.275	.671	.169	1	.681	.759	.204	2.826
	$10,000- < $15,000	.189	.562	.113	1	.736	1.208	.402	3.635
	$15,000- < $20,000	.739	.491	2.268	1	.132	2.094	.800	5.479
	$20,000- < $25,000	-.010	.528	.000	1	.984	.990	.352	2.784

$25,000- < $35,000	.482	.470	1.050	1	.306	1.619	.644	4.068
$35,000- < $50,000	-.234	.445	.277	1	.599	.791	.331	1.893
$50,000- < $75,000	.097	.418	.054	1	.817	1.102	.486	2.497
> $75,000	1.318	.507	6.751	1	.009	3.736	1.382	10.097
Male	.150	.219	.466	1	.495	1.162	.756	1.786
Race ethnicity			11.082	6	.086			
White	.448	.424	1.112	1	.292	1.564	.681	3.595
African America	1.146	.531	4.663	1	.031	3.146	1.112	8.902
Alaska Native	.094	.781	.014	1	.904	1.098	.238	5.071
Asian								
Asian Indian	-.893	.806	1.225	1	.268	.410	.084	1.989
Chinese	1.793	1.327	1.825	1	.177	6.007	.445	81.016
Filipino	-.518	.806	.413	1	.520	.596	.123	2.893
Respondents Aged18-64			1.434	2	.488			
Age in years	-.235	.326	.518	1	.472	.791	.417	1.499
Don’t know age	-.618	.518	1.425	1	.233	.539	.195	1.487
Marital status			8.456	6	.207			
Married	-.086	1.270	.005	1	.946	.917	.076	11.057
Divorced	-.221	1.290	.029	1	.864	.802	.064	10.052
Widowed	-1.253	1.320	.902	1	.342	.286	.021	3.795
Separated	-.318	1.427	.050	1	.824	.728	.044	11.920
Never married	-.285	1.298	.048	1	.826	.752	.059	9.581
Member of unmarried couple	-1.095	1.522	.518	1	.472	.334	.017	6.604

Educational level			10.508	5	.062			
None	22.080	40192.804	.000	1	1.000	3885254695.000	.000	.
Elementary	21.730	40192.804	.000	1	1.000	2736793677.000	.000	.
Some high school	20.439	40192.804	.000	1	1.000	752315267.700	.000	.
High school graduate	20.619	40192.804	.000	1	1.000	901060331.800	.000	.
Some college or technical school	20.776	40192.804	.000	1	1.000	1054532267.000	.000	.
Employment status			9.105	8	.333			
Employed for wages	-21.835	28042.139	.000	1	.999	.000	.000	.
Self employed	-22.067	28042.139	.000	1	.999	.000	.000	.
Out of work for 1 year or more	-21.960	28042.139	.000	1	.999	.000	.000	.
Out of work for less than 1 year	-22.683	28042.139	.000	1	.999	.000	.000	.
A Home make	-21.716	28042.139	.000	1	.999	.000	.000	.
A student	-23.085	28042.139	.000	1	.999	.000	.000	.
Retired	-22.231	28042.139	.000	1	.999	.000	.000	.
Unable to work	-21.257	28042.139	.000	1	.999	.000	.000	.
Constant	.358	49008.835	.000	1	1.000	1.431		

a. Variable(s) entered on step 1: Exercise in Past 30 Days, Income Level, Respondents Sex, Race-Ethnicity, Respondents Age, Marital Status, Education Level, Employment Status.

Research Question 2 (RQ 2):To what extent do social determinants of health (money for balanced meals, finances at the end of month, and poor mental health), household income, and respondent sex predict respondents' weight/BMI after controlling for geographic location, race, age, marital status, education, and employment?

Null Hypothesis ($H_0 2$): Social determinants of health (money for balanced meals, finances at the end of month, and poor mental health), household income, and respondent sex do not predict respondents' weight/BMI after controlling for geographic location, race, age, marital status, education, and employment.

Alternative Hypothesis ($H_1 2$): Social determinants of health (money for balanced meals, finances at the end of month, and poor mental health), household income, and respondent sex do predict respondents' weight/BMI after controlling for geographic location, race, age, marital status, education, and employment.

Binary logistic regression analysis was conducted to determine the association between the predictor variables and response variable. The predictor variables for the binary logistic regressionweresocial determinants of health (money for balanced meals, finances at the end of month, and poor mental health), household income, and respondent sex. The outcome variable was weight/BMI and confounding variables were geographic location, race, age, marital status, education, and employment.

Table 21 shows statistically significant model ($p< 0.001$) indicating a good model fit. Table 22 explains variation in the dependent variable that ranges from 52.6% to 71.5%. Since Nagelkerke R^2 cannot achieve a value of 1, Negelkerke R^2 value was preferably reported. Table 23 is Hosmer and Lemeshow's test which is another Chi square test and was not statisticallysignificant ($p = 0.88$). Table 24 is a classification table that has a probability cut off value of 0.5 indicating that the estimated probability of obese occurring is greater than or equal to 0.5; while if probability is less than 0.5, the event is classified as not obese. Table 25 is variables in equation that shows the contribution made by every independent variable to the model and its statistical significance. The result shows no independent variable was statistically significant since the *p* values were far above 0.05. This indicates that there was no statistically significant relationship between the independent variables and the weight/BMI as it fails to reject the null hypothesis. Therefore, the answer to research question 2 is 'Social determinants of health (money for balanced meals, finances at the end of month, and poor mental health), household income, and respondents sex do not predict respondents' weight/BMI after controlling for geographic location, race, age, mental status, education, and employment. Binary logistic regression was performed to determine the predicting effects of social determinants of health (money for balanced meals, finances at the end of month, and poor mental health), household income, and respondent sex on the likelihood of being obese or not obese after controlling for geographic location, race, age, marital status, education, and employment. The binary logistic regression model was statistically significant ($p< 0.001$). The model explained 71.5% (Negelkerke R^2) of variance in obese and has correctly classified 87.9% of obese cases. However, no statistically significant result was seen.

Table 21

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	68.016	33	.000
	Block	68.016	33	.000
	Model	68.016	33	.000

Table 22

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	53.247[a]	.526	.715

a. Estimation terminated at iteration number 20 because maximum iterations has been reached. Final solution cannot be found.

Table 23

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	3.646	8	.888

Table 24

Classification Table[a]

			Predicted		
			Body Mass Index		Percentage
	Observed		Not Obese	Obese	Correct
Step 1	Body Mass Index	Not Obese	55	1	98.2
		Obese	10	25	71.4
	Overall Percentage				87.9

a. The cut off value is .500

Table 25

Variables in the Equation

	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
							Lower	Upper

Step 1[a]	No money for balanced meals?			.000	3	1.000			
	Often true		17295848.370	.000	1	1.000	3.558E+90	.000	.
	Sometimes true	117.669	17295874.700	.000	1	1.000	1.268E+51	.000	.
	Never true	151.821	17295883.170	.000	1	1.000	8.611E+65	.000	.
	How do your finances usually work out at			2.194	2	.334			
	End up with some money left over	15.861	20398.124	.000	1	.999	7729481.658	.000	.
	Have just enough money to make end	17.210	20398.124	.000	1	.999	29785934.420	.000	.
	Computed mental health status			.005	2	.997			
	None of the time	65.693	13370.835	.000	1	.996	339087889200000000000000000000.000	.000	.
	A little of the time	65.620	13370.835	.000	1	.996	315130052400000000000000000000.000	.000	.
	Income level			1.410	8	.994			

Don’t know	-4.769	45072.811	.000	1	1.000	.008	.000	.
Less than $10,000	-15.843	14142.728	.000	1	.999	.000	.000	.
$10,000- < $15,000	68.139	22566.982	.000	1	.998	391323411300000000000000000000.000	.000	.
$15,000- < $20,000	-.322	2.349	.019	1	.891	.724	.007	72.385
$20,000- < $25,000	.468	2.280	.042	1	.838	1.596	.018	139.260
$25,000- < $35,000	-1.434	1.697	.714	1	.398	.238	.009	6.638
$35,000- < $50,000	-.873	1.341	.424	1	.515	.418	.030	5.783
$50,000- < $75,000	18.655	5267.420	.000	1	.997	126404277.000	.000	.
Male respondents	.092	.812	.013	1	.910	1.096	.223	5.384
Respondents aged 18-64	-.386	2.535	.023	1	.879	.680	.005	97.735
Race-ethnicity			2.966	4	.564			
White	-1.915	1.874	1.044	1	.307	.147	.004	5.804
African American	.430	2.463	.031	1	.861	1.538	.012	191.993
American Indian	30.920	17295690.990	.000	1	1.000	26824943330000.000	.000	.
Asian Alaska Native	-48.084	12572372540.000	.000	1	1.000	.000	.000	.
Marital status			.528	3	.913			
Married	-.243	1.474	.027	1	.869	.784	.044	14.104
Divorced	-37.302	25006.989	.000	1	.999	.000	.000	.

Widowed	-2.289	3.424	.447	1	.504	.101	.000	83.283
Educational level			1.259	4	.868			
None	113.659	35733.957	.000	1	.997	2.298E+49	.000	.
Elementary	141.686	52085.234	.000	1	.998	3.415E+61	.000	.
Some high school	-2.438	2.180	1.251	1	.263	.087	.001	6.261
High school graduate	-.583	1.399	.173	1	.677	.558	.036	8.671
Employment status			.884	5	.971			
Employed for wages	-35.387	11584.550	.000	1	.998	.000	.000	.
Self employed	-35.602	11584.550	.000	1	.998	.000	.000	.
Out of work for 1 year or more	-54.496	41829.136	.000	1	.999	.000	.000	.
Out of work for less than 1 year	-33.283	11584.550	.000	1	.998	.000	.000	.
Home make	-35.538	11584.550	.000	1	.998	.000	.000	.
Constant	-196.046	17295993.750	.000	1	1.000	.000		

a. Variable(s) entered on step 1: No Money for Balanced Meals?, How do Your Finances Usually Work Out at the end of Month, Computed Mental Health Status, Income Level, Respondents Sex, Respondents Age, Race-Ethnicity, Marital Status, Education Level, Employment Status.

RQ 3: To what extent do diet (fruit, fruit juice, potato, and dark green vegetable consumption), household income, and respondent sex predict respondents' weight/BMI after controlling for geographic location, race, age, marital status, education, and employment?

*H*2*0* Diet (fruit, fruit juice, potato, and dark green vegetable consumption), household income, and respondent sex do not predict respondents' weight/BMI after controlling for geographic location, race, age, marital status, education, and employment.

*H*2*1* Diet (fruit, fruit juice, potato, and dark green vegetable consumption), household income, and respondent sex predict respondents' weight/BMI after controlling for geographic location, race, age, marital status, education, and employment.

Binary logistic regression analysis was conducted to determine the association between the predictor variables and response variable. The predictor variables for the binary logistic regressionwerediet (fruit, fruit juice, potato, and dark green vegetable consumption), household income, and respondent sex. The outcome variable was weight/BMI and Confounding variables were geographic location, race, age, marital status, education, and employment.

Table 26 is the Omnibus test of model coefficient that shows a statistically significant model (p = 0.009) indicating a good model fit. Table 27 explained variation in the dependent variable that ranges from 12.4% to 17.3%. Since Nagelkerke R^2 cannot achieve a value of 1, Negelkerke R^2 value was preferably reported. Table 28 is Hosmer and Lemeshow's test which is another Chi square test and was not statistically significant (p = 0.798). Table 29is aclassification table that has a probability cut off value of 0.5 indicating that the estimated probability of obese occurring is greater than or equal to 0.5; while if probability is less than 0.5, the event is classified as not obese. Table 30 is variables in equation that shows the contribution made by every independent variable to the model and its statistical significance. The result shows household income ≥ $75,000/annum ($p$ = 0.025, 95%CI = 1.17, 10.26), and African American race (p = 0.05, 95%CI = 0.99, 9.08) added significantly to the model/prediction. This indicates a statistically significant relationship between household income level and weight/BMI, similarly, there was a statisticallysignificant relationship between respondent's race and weight/BMI. Hence, the null hypothesis is rejected and the answer to the research question 3 is 'household income and respondent's race do predict respondents weight/BMI after controlling for geographic location, age, marital status, education, and employment'. However, every other independent variable including confounding variables were not statistically significant (since the$p$value was far above 0.05) and did not add to the significance of the model; this fails to reject null hypothesis.Therefore, to answer the research question,'diet (fruit, fruit juice, potatoes, and dark green vegetable consumption), respondents' sex do not predict respondents' weight/BMI after controlling for geographic location, age, marital status, education and employment.

Binary logistic regression was performed to determine the predicting effects of diet (fruit, fruit juice, potato, and dark green vegetable consumption), household income, and respondent sex on the likelihood of being obese or not obese after controlling for geographic location, race, age, marital status, education, and employment. The binary logistic regression was statistically significant ($p < 0.01$). The model explained 17.3% (Negelkerke R^2) of variance in obese and has correctly classified 72.1% of obese cases. Increase in one unit of household income level ≥ $75,000/annum has 3.5 times more likelihood to be obese than every other household income level. Similarly, an increase in one African American race has 3.0 times more likelihood of becoming obese.

Table 26

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	65.187	41	.009
	Block	65.187	41	.009
	Model	65.187	41	.009

Table 27

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	556.108[a]	.124	.173

a. Estimation terminated at iteration number 20 because maximum iterations has been reached. Final solution cannot be found.

Table 28

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	4.615	8	.798

Table 29

Classification Table[a]

			Predicted		
			Body Mass Index		Percentage
	Observed		Not Obese	Obese	Correct
Step 1	Body Mass Index	Not Obese	306	24	92.7
		Obese	113	48	29.8
	Overall Percentage				72.1

a. The cut off value is .500

Table 30

Variables in the Equation

	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
							Lower	Upper

Step 1[a]	Fruit juice intake per day	.000	.002	.012	1	.912	1.000	.996	1.005
	Fruit intake per day	.001	.001	.890	1	.345	1.001	.999	1.003
	Dark green vegetable intake in	-.001	.002	.258	1	.612	.999	.994	1.003
	Potato servings per day	-.005	.004	1.822	1	.177	.995	.988	1.002
	Income level			13.902	9	.126			
	Don't know	.563	.681	.685	1	.408	1.757	.463	6.671
	Less than $10,000	-.245	.720	.116	1	.734	.783	.191	3.212
	$10,000- < $15,000	.563	.599	.885	1	.347	1.757	.543	5.681
	$15,000- < $20,000	.907	.543	2.790	1	.095	2.477	.855	7.181
	$20,000- < $25,000	.139	.579	.058	1	.810	1.149	.370	3.571
	$25,000- < $35,000	.814	.522	2.431	1	.119	2.257	.811	6.277
	$35,000-< $50,000	-.080	.486	.027	1	.869	.923	.356	2.394
	$50,000- < $75,000	.291	.460	.400	1	.527	1.338	.543	3.299
	$75,000 and above	1.241	.555	5.005	1	.025	3.458	1.166	10.255
	Male respondents	.221	.230	.917	1	.338	1.247	.794	1.958
	Race-ethnicity			9.550	6	.145			
	White	.426	.455	.878	1	.349	1.531	.628	3.733
	African American	1.098	.566	3.765	1	.052	2.997	.989	9.081
	American Indian	-.044	.861	.003	1	.959	.957	.177	5.170
	Asian Alaska native	-.814	.805	1.023	1	.312	.443	.091	2.146
	Asian Indian	1.903	1.326	2.061	1	.151	6.706	.499	90.148
	Chinese	-.296	.829	.127	1	.721	.744	.147	3.779

Respondents aged 18-64			2.710	2	.258			
Respondents age coded in years	-.388	.337	1.328	1	.249	.678	.350	1.313
Don’t know their age	-.873	.544	2.579	1	.108	.418	.144	1.212
Marital status			9.429	6	.151			
Married	-.315	1.279	.061	1	.806	.730	.060	8.952
Divorced	-.469	1.303	.130	1	.719	.625	.049	8.045
Widowed	-1.699	1.341	1.606	1	.205	.183	.013	2.531
Separated	-.780	1.497	.272	1	.602	.458	.024	8.616
Never married	-.466	1.311	.126	1	.722	.628	.048	8.202
A member of married couple	-1.218	1.547	.620	1	.431	.296	.014	6.133
Education level			5.578	5	.349			
None	21.637	40190.973	.000	1	1.000	2493955914.000	.000	.
Elementary	21.856	40190.973	.000	1	1.000	3104073160.000	.000	.
Some high school	20.660	40190.973	.000	1	1.000	939161534.400	.000	.
High school graduate	20.750	40190.973	.000	1	1.000	1026799494.000	.000	.
Some college or technical school	20.880	40190.973	.000	1	1.000	1169326064.000	.000	.

Employment status			12.256	8	.140			
Employed for wages	-21.521	28414.093	.000	1	.999	.000	.000	.
Self employed	-21.764	28414.093	.000	1	.999	.000	.000	.
Out of work for 1 year or more	-21.835	28414.093	.000	1	.999	.000	.000	.
Out of work for less than 1 year	-21.950	28414.093	.000	1	.999	.000	.000	.
A home make	-21.353	28414.093	.000	1	.999	.000	.000	.
A student	-22.576	28414.093	.000	1	.999	.000	.000	.
Retired	-21.912	28414.093	.000	1	.999	.000	.000	.
Unable to work	-20.531	28414.093	.000	1	.999	.000	.000	.
Constant	-.031	49217.124	.000	1	1.000	.969		

a. Variable(s) entered on step 1: Fruit Juice Intake in Times Per, Computed Fruit Intake in Times Per Day, Dark Green Vegetable Intake in a day, Potato Servings Per Day, Income Level, RespondentsSex, Race-Ethnicity, Respondents Age, Marital Status, Education Level, Employment Status.

Summary

Binary logistic regression was performed to address research question one in order to determine the predicting effects of frequency of physical activity, household income, and respondent sex on the likelihood of being obese or not obese after controlling for geographic location, race, age, marital status, education, and employment. The model was statistically significant ($p < 0.005$) and it explained 16.6% (Negelkerke R^2) of variance in obese and has correctly classified 70.5% of obese cases. Both household income level (>$75,000) and race/ethnicity (African American) were statistically significant (*p* = 0.009, Odds = 3.74, 95%CI = 1.38, 10.10), and (*p* = 0.031, Odds = 3.15, & 95% CI = 1.11, 8.90) with positive coefficients respectively hence the null hypothesis was rejected and the alternative hypothesis was accepted.

Similarly, to address research question two, binary logistic regression was also performed to determine the predicting effects of social determinants of health (money for balanced meals, finances at the end of month, and poor mental health), household income, and respondent sex on the likelihood of being obese or not obese after controlling for geographic location, race, age, marital status, education, and employment. The binary logistic regression model was statistically significant ($p< 0.001$) with Omnibus test of coefficients. The model explained 71.5% (Negelkerke R^2) of variance in obese and has correctly classified 87.9% of obese cases. However no statistically significant result was seen, indicating that no independent variable contributed to the model, hencethe null hypothesis cannot be rejected and the answer to the research question was: Social determinants of health (money for balanced meals, finances at the end of month, and poor mental health), household income, and respondents sex do not predict respondents' weight/BMI after controlling for geographic location, race, age, mental status, education, and employment.

Furthermore, research question three was addressed by performing binary logistic regression to determine the predicting effects of diet (fruit, fruit juice, potato, and dark green vegetable consumption), household income, and respondent sex on the likelihood of being obese or not obese after controlling for geographic location, race, age, marital status, education, and employment. The binary logistic regression was statistically significant ($p < 0.01$) with Omnibus test of model coefficients. The model explained 17.3% (Negelkerke R^2) of variance in obese and has correctly classified 72.1% of obese cases. Both household income level (>$75,000) and race/ethnicity (African American) were statistically significant ($p = 0.025$, Odds = 3.50, 95%CI = 1.17, 10.26), and ($p = 0.05$, Odds = 3.00, & 95% CI = 0.90, 9.08) with positive coefficients respectively, hence the null hypothesis was rejected and the alternative hypothesis accepted.

Chapter 5 will include discussion and interpretation of findings, limitations, recommendations, implications for social change, and conclusion.

Chapter 5: Discussion, Conclusions, and Recommendations

Introduction

The purpose of this quantitative study was to determine the extent to which frequency of physical activity, household income, social determinants of health (money for balanced meals, finances at the end of month, and poor mental health), respondent sex, and diet (fruit, fruit juice, potato, and dark green vegetable consumption) predict respondents' weight/BMI in the United States of America, after controlling for potential confounders (geographic location, race, age, marital status, education, and employment).The key findings of the statistical analysis showedthat household income and race/ethnicity are predictors of weight/BMI among household adults in the 50 States of the United Statesafter controlling for geographic location, race, age, marital status, education, and employment.

Interpretation of the Findings

Some findings in my study were in conformity with other studies, while some were not. The proportion of obese respondents in this study was a true reflection of the prevalence of obesity in the United States. The percentage of obese respondents in this study was 34.3% and this is in conformity with the report of Flegal, Carrol, Kit,and Ogden (2012) that 36.0% of adults at the age of 20 years and above were classified as obese. Similarly, Morgen and Sorensen (2014) reported that in advanced industrialized countries, prevalence of obesity ($BMI \geq 30kg/m^2$) among men rose from 28.8% to 36.9% in the period of 1980 to 2013; among women, the prevalence rose from 29.8% to 38.0%

during the same period.Generally, this report was consistent with the proportion of34.3% of obese respondents in this study.

A statistically significant relationship between household income level and weight/BMI was seen in my study. The result indicated a significant statistical relationship between highest level of household income (≥ $75, 000/annum) and obesity in a positive direction, as against the inverse relationship between household income and obesity described by Bentley et al. (2018). This finding however, was contrary to the study conducted by Bentley et al. (2018), with the result that poor American people were reported to be disproportionately affected by obesity and further identified 33% of American adults whose annual earnings were low (≤ $15,000.00) per annum as obese and the 24.6% of Americans whose earnings were $50,000.00 and above per annum as likely not to be obese. The result of this study is in conformity with the result of study conducted by Ogden et al. (2017) in which obesity prevalence was found to be higher in highest income group than in the lowest income group among non-Hispanic black men. Theresults of my study further revealed a statistically significant association between respondent's race and weight/BMI which indicated that respondents' race was a predictor of weight/BMI. This finding is in conformity with the result of the previous study conducted by Mui, Hill, and Thorpe (2018) that variations exist in prevalence of overweight and obesity within and among racial groups identifying race as a good predictor of overweight/obesity. This study identified black/African American race a predictor of obesity. This was in conformity with the report of Gillespie and Christian (2016) that in the United States obesity was high among African Americans with the estimate that 49.6% of adult African Americans were obese. This result was consistent with the assertion that normal weighted white had significantly lower BMI compare to their African American counterparts (Gillespie & Christian, 2016).

No statistically significant relationship was found in my study between the independent variables and weight/BMI. The results showed that social determinants of health (money for balanced meals, finances at the end of the month, and poor mental health), household income, and respondents' sex do not predict respondents' weight/BMI after controlling for geographic location, race, age, mental status, education, and employment. These findings were inconsistent with the findings from the previous studies such as a study conducted by Peralta, Amos, Lipert, Martins, and Marques (2018) that demonstrated prevalence of obesity as age and sex dependent and further indicated that high prevalence of obesity was demonstrated amongst the European adults (age ≥ 50 years), and another study conducted in the United States by Bentley et al. (2018) that established an inverse relationship between household income and obesity.

In this research, diet (fruit, fruit juice, potato, and dark green vegetable consumption) and respondent sex were not statistically significant;in view of this, the two independent variables did not predict weight/BMI. Moreover, a statistically significant relationship between household income level and weight/BMI was seen. The result indicated a significant statistical relationship between highest level of household income (≥ $75, 000/annum) and obesity in a positive direction as against the inverse relationship between household income and obesity described by Bentley et al. (2018). This finding however, was contrary to the study conducted by Bentley et al. (2018) with the result that poor American people were reported to be disproportionately affected by obesity and further identified 33% of American adults whose annual earnings were low (≤ $15,000.00) per annum as obese and the 24.6% of Americans whose earnings were $50,000.00 and above per annum as likely not to be obese. In another way round the result of this study is in conformity with the result of study conducted by Ogden et al. (2017) in which obesity prevalence was found to be higher in highest income group than in the lowest income group among non-Hispanic Black men. Furthermore, a statistically significant association between respondent's race and weight/BMI which indicated that respondents' race was a predictor of weight/BMI. This finding is consistent with the result of the previous study conducted by Mui, Hill, and Thorpe (2018) that showed variations exist in prevalence of overweight and obesity within and among racial groups identifying race as a good predictor of overweight/obesity. This study identified Black/African American race a predictor of obesity. This was in conformity with the report of Gillespie and Christian (2016) that in the United States prevalence of obesity was high among African Americans.

The SCT was chosen as the framework for this study because it links peoples' confidence in adaptation to new behavior trends especially if these people perceive that they have relative advantage over their current behaviors. Success of the new behavior will stand a better chance to succeed in alleviating high prevalence of overweight/obesity worldwide, particularly in the developing nations of the world. This is in conformity with the findings of McAlister et al. (2008), who advocated that new behavior is compatible with daily routines and aligned with sociocultural values and priorities. For these reasons, researchers have used SCT to guide obesity intervention programs, having determined the predictors with good results (Nerud& Samra, 2017).

This study revealed statistically significant association between household income and overweight/obesity, in addition to a significant association between respondents' race and overweight/obesity. These findings identified household income and respondents' race as predictors of overweight/obesity. The intervention programs using SCT for adult overweight/obesity should pay attention to household income and respondents' race as predictors of obesityusing key constructs of SCT, the external and internal reinforcement as well as self-efficacy to achieve the behavior change that can be maintained over time.

Limitations of the Study

The most important limitation of this research was that variables such as calorie intake, social capital, and psychological state of the respondents were not directly available from the dataset. This was addressed by using similar variables provided in the dataset such as social determinants (money for balanced meals, finances at the end of month, and poor mental health), and diets (fruits, fruit juice, potato, and dark green vegetable consumption). Furthermore, lack of longitudinal data on individual body weight/BMI may lead to inability to derive further inference about the causal effect of some predictors such as educational attainment on changes in weight/BMI of the respondents. TI used the cross-sectional design approach of this study to address the issue of lack of longitudinal data on individual body weight/BMI. In addition,manymissing values from the variables were encountered during the statistical analysis. This can be addressed by using a larger sample size for better power, generalizability, and reliability of the research findings.In terms of validity, there were three threats tointernal validity identified as appropriate to this study and these include: selection-maturation, interaction, and regression. Selection was addressed by using probability sampling in the form of simple random sampling. This randomization ensured higher internal validity. Interaction was addressed by controlling for the potential confounding variables (geographic location, race, age, marital status, education, and employment) during the hypothesis testing. Regression threat was addressed by using binary logistic regression test to examine the association between the independent (predicting) variables and dependent (dichotomous) variables for each research question and their specific hypothesis.

Recommendations

The participants in this study were household adults living in the 50 states of the United States, District of Columbia, Puerto Rico, the U. S. Virgin Islands, Guam, American Samoa, and Palau. I would recommend quantitative research to be carried out on similar adult populations living in other parts of the world, especially in developing countries to allow better racial diversity, different geographic locations, and to improve on the knowledge of obesity in developing countries.Futurequalitativestudies are recommended since individual perceptions and beliefs could help researchers to understand the meaning and experience of an individual’s knowledge on obesity.

Implications

In this study Ideterminedthe extent to which frequency of physical activity, household income, social determinants of health money for balanced meals, finances at the end of month, and poor mental health), respondent sex, and diet (fruit, fruit juice, potato, and dark green vegetable consumption) predict respondent weight/BMI in the United States, after controlling for potential confounders (geographic location, race, age, marital status, education, and employment) andthe findings revealed household income and respondents' race as predictors of weight/BMI.Theoriginal thought was that this research could provide more predictors of weight/BMI from frequency of physical activity, household income, social determinants, respondent sex, and diet in the United States. Furthermore, as obesity becomes more prevalent in countries where it was previously rare (Lee, 2017), and identified as the fourth leading risk factor for global mortality (Arbel et al., 2019), the findings from this study couldpromote positive social change bytargetingoverweight/ obesity intervention and subsequently checkpremature mortality at community level intervention. In addition, findings of this research could allow practical application as it is aligned with social cognitive theory that links peoples' confidence in adaptation to new behavior trends as they perceive that they have relative advantage over the unhealthy behavior. Moreover, the identified predictors of weight/obesity (household incomeandrespondents' weight) can be used to aid in the intervention of overweight/obesity in the society thereby reducing associated morbidity and mortality. The knowledge of these potential predictors from peoples' awareness could bring about positive social change in the society through improvement in the health of the population, increase in life expectancy, and improvement in human productivity.

Conclusion

Data from the 2017 BRFSS secondary dataset was used to determine the extent to which frequency of physical activity, household income, social determinants of health money for balanced meals, finances at the end of month, and poor mental health), respondent sex, and diet (fruit, fruit juice, potato, and dark green vegetable consumption) predict respondent weight/BMI in the United States, after controlling for potential confounders (geographic location, race, age, marital status, education, and employment). The findings revealed that both household income and respondents' race were statistically significant indicating that household income and respondents' race were predictors of weight/BMI. This implies that for every dollar increase in household income above $75,000 and for every increase in number of African American adult there are more chances of adulthood obesity. This is to say that African Americans are more likely to experience obesity.

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